THE

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THE

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THE AMENDMENT OF THE PATENT LAW.

MR. GERALD BALFOUR'S "Bill to amend the Law with reference to Applications for Patents and Compulsory Licenses and other matters connected therewith," has now been printed.

The improvements in the procedure for obtaining compulsory licenses from obstinate patentees appear to mark a great advance on the old procedure, which was practically unworkable. Though the cases may be very rare, where the patentee of a valuable invention will refuse to sell, or to grant licenses to manufacturers, still such cases might occasionally be met with, and the Courts should have full power to prevent this abuse of the Royal grant. The amendments in Mr. Balfour's Bill appear to secure this desirable end, without introducing any of the vexatious restrictions as to the working of the invention within two or three years, such as exist in the Patent Laws of France and Germany.

The remainder of the Bill relates to the examination of specifications for novelty, and is not so satisfactory. Every complete specification of an invention filed at the Patent Office is to be submitted to an Examiner. After mastering the contents of the specification, the Examiner is to make search among all complete specifications recorded in the British Patent Office within the previous 50 years. If the Examiner finds among these specifications any anticipation of the whole or a part of the applicant's invention, the applicant is to be informed, and given the opportunity of withdrawing or amending his specification before he receives his patent. If, however, the applicant for a patent refuses to make any alteration in his specification, although the report of the Examiner may have shown him that his invention is not new, he can still demand his letters patent. The only step taken by the Patent Office to protect the public from being mulcted by the holder of an illegal monopoly, is the comparatively futile proceeding of causing reference to the anticipating specifications to be inserted in the specification of the bogus patent.

Under the present *laissez-faire* condition of our Patent Law, there is, as most of our readers know, no examination of inventions for novelty. According to the report of the Board of Trade Committee which inquired into the working of the Patent Acts last year, 42 per cent. at least of the patents granted at the present time are in whole or in part invalid through want of novelty. The real percentage is probably much higher, as the search was confined to a limited field and to a limited period. Many, if not all, of these patents are taken out as the Committee's report mildly puts it "for objects other than the protection of a real invention." The Committee also state in their report that they are of opinion that the grant of invalid patents is a serious evil, inasmuch as it tends to the restraint of trade and to the embarrassment of honest traders and inventors. They might have

added that the consumers of patented articles are practically compelled by the State to pay enhanced prices for such articles to a person who is not the inventor, and therefore has no proprietary right to any payment whatever over the price which would be fixed by open competition.

This Bill, therefore, though professing to be founded on the report of the Board of Trade Committee, fails completely to remedy the serious evils which the Committee considered to appertain to the granting of invalid patents. The endorsement of the specification of the bogus invention with references to the anticipating patents appears to us to be no remedy. It is not the cost of a search that deters the blackmailed manufacturer from resisting the demands of a bogus patentee for royalties. In most cases, in fact, the manufacturer knows quite well that the invention is not new and that the patent is invalid. The real deterrent is the fear of a lawsuit and the loss of time and money which it involves, even though the defence should be successful. Complete statistics of the extent to which blackmailing is carried by bogus patentees are difficult to obtain, but we know of several instances where manufacturers have paid considerable sums for royalties on patents which they were convinced were invalid, rather than go to the trouble and expense of contesting the matter in Court.

The additional cost of carrying out the scheme of examination for novelty proposed in the Bill is estimated at about £65,000 per annum. Since an additional fee of £1 is to be exacted on the sealing of each patent, the cost will be thereby reduced to about £50,000 per annum. After paying this additional sum the Patent Office will probably still have an annual surplus of upwards of £100,000 per annum. There can be no objection, therefore, raised on the ground that patentees do not pay for the information as to the novelty of their inventions which will be supplied to them by the Patent Office. In fact, the Patent Office surplus is so large that there appears to be little justification for the imposition of the additional fee of £1 on sealing. It is intended apparently to prevent the bogus inventor applying for the seal, *i.e.*, the genuine inventor is to be mulcted to the extent of £1, in the hope of frightening the bogus inventor out of the field. The proceeding is a very unfair one, and, moreover, we do not think it will succeed.

Undoubtedly the *bonâ fide* inventor would benefit by the cheap search which would be carried out for him under the provisions of this Bill, but when we consider that without the expenditure of an additional penny, the manufacturing public, and the consuming public, might also be protected by giving the Patent Office power to reject all inventions or parts of inventions that were found to be anticipated, it is inconceivable that the Government have failed to introduce into the Bill a provision to secure this desirable result.

The dangers of official examination to *bonâ fide* inventors are evidently greatly exaggerated. Both the United States and Germany have had systems of effective examination in force for many years. The industrial progress of both those countries in recent years has been so great as to seriously threaten our own pre-eminence, especially in the mechanical and chemical arts where large amounts of capital are invested in patents. In neither of these countries is there any general movement to abolish examination of patents for novelty. Patentees are convinced that it makes their patents more saleable and valuable, and purchasers of patents can buy with immensely reduced risk of finding their purchases valueless. The average quality of inventions filed in the Patent Office will also improve when intending applicants for letters patent know that they have little chance of obtaining a patent except they have made a real advance on previous knowledge.

We hope that this Bill will be modified in Committee by introducing a provision to enable the Comptroller of Patents to reject anything in a patent which is reported to him by the Examiner as having been anticipated, there being, of course, a final appeal to the law officer. We should like to see the field for search extended much beyond 50 years of British patents, but even this fraction of a loaf would be better than no bread, and the field might be extended afterwards when experience showed that search could be made effective in the wider extent.

Electric Legislation and Finance.

A PAPER was read by Mr. H. W. Handcock upon the above matter on the 10th inst. at the meeting of the Newcastle Local Section of the Institution of Electrical Engineers. The subject is a very practical one, the relations between electrical matters—legislation and finance—being, as Mr. Handcock points out, much closer than many people suppose. We must differ from the author in his belief that the Electric Lighting Acts of 1882 and 1888 have worked well; on the contrary, the 1882 Act may be said not to have worked at all, while the 1888 Act, although improving the terms under which local authorities can acquire the undertakings, did not remove the serious difficulties under which the industry has suffered from the practical veto and preference given to the municipalities. We do not quite follow Mr. Handcock in his contention that there is a sharply defined line between the engineer, the financier, and the legal adviser. They are naturally dependent upon one another; the legal adviser, or in other words, the legislature, prescribes what you *may* do, the financier provides for what *can* be done, and the engineer cuts his coat according to the cloth, and does what he is able with the means and the conditions at his disposal. We endorse Mr. Handcock's tribute to the officers of the Board of Trade; all who come in contact with them will bear willing testimony to their courtesy and readiness to deal with every case on its merits, but they are restricted in their action by the terms of the Acts of Parliament they administer, which were framed in the interests of municipalities who have taken full advantage of their power to obstruct the industry.

We are inclined to doubt Mr. Handcock's assertion that the local authority represents the ratepayers in matters electrical; as a rule, there is so much apathy and indifference on the part of the ratepayers as to who represents them, that the town councils often appear to consider themselves as altogether independent of their constituents. Numerous instances have occurred—especially within a recent period—where the local authorities have been defeated on an appeal to the ratepayers to sanction schemes for municipal trading in electricity: witness Birmingham, South Shields, Finchley, &c. Mr. Handcock thinks that if it is simply a question of electric light and power, the local authority should certainly be in a position to deal with these commodities themselves as representatives of the population within their area. Why, one would suppose that there is nothing simpler than giving a supply of electricity, and that it is as easy as tar-paving a footpath or collecting dust and the rates. We

admit that it is the ratepayer's own fault if he suffer in purse by allowing his representatives to trade without knowledge—and with his money!

Mr. Handcock's views on the position of local authorities with respect to tramways and light railways require reconsideration. He seems to advocate that the traffic within the boundary of the municipality should be in their hands—with running powers for a company dealing with the outside districts—and suggests as a practical scheme, that the local authority should allow some of their cars to be replaced by those of the company, which he innocently believes would present "no insuperable difficulty."

The Labour Question.

THE working agreement to which we referred last week regarding the Employers' Federation and the Trades Unions was rejected by the men in the ratio of 7,379 to 14,879. The membership of the societies involved numbers 110,000, so that only one-fifth of the whole were polled. Of the adverse majority the bulk were members of the A.S.E., which includes 90,000 men, so that less than one-sixth of the A.S.E. were adverse sufficiently to vote. The apathy of the majority may, perhaps, be a good sign, yet at the same time, it is just this apathetic majority that lets itself be dragged at the tail of the active members' chariot and drifts into strikes against its wish. Thus, the voters who do represent the active members have shown that they are largely against the agreement.

The *Times* thinks that the negative vote, such as it is, is due to the men's misconception of the piecework clause, and that further discussion which is anticipated will, after all, bring a vote for the agreement. The agreement was supposed to have had its origin in the idea held by the men that the settlement of 1898 was rather harsh. As the employers were willing to have gone on with the terms of that settlement, it seems a pity that the men who proposed the new agreement have not seen fit to ratify it. The fact that it was provided that no local strike or lock-out should be entered upon without reference to headquarters provided a great safeguard against local disputes. The reference to headquarters must always tend to give time for passions to cool. A contemporary suggests that to this very fact may, perhaps, be attributed the rejection of the agreement at the instigation of the local officials, who, if quarrels are to be referred to headquarters, may find themselves in the position of Othello. There was a certain childishness in the whole plan of the agreement, but this seems to be a feature common to all such, for they appear to be made up of permits to do what is sensible and refusals to act foolishly that have an air of superfluity about them. It seems absolute folly to require to say anything about the restriction of output of a machine. If the restriction of machine output is right and proper, then the whole machine is a crime, and ought never to have been invented. We can understand and appreciate fully the attitude of the early machine wreckers of the days of Arkwright and of Hargreaves or Heathcote, but having accepted the principle of the machine, we entirely fail to see reason in restricting the output of the iron beast. Also, upon what principle is the doctrine of restriction worked? A machine tool employed to make part of a locomotive must be restricted. The locomotive, when in its turn it is set to work, is, we believe, free from restrictions as to the tonnage it may haul. There is no logic in the position. It is remarkable that the greatest efforts of trades unions have been exerted in wrong directions, *e.g.*, to restricting machine output in place of shortening the hours of human toil, which it should be the aim of machinery to bring about, and that would have been brought about if all classes had only recognised their community of interests, and put a stop to much unnecessary work which is now done.

DIA'S PATENT WATERPROOF CABLE.

THE St. Helens Cable Company, Limited, are placing upon the market a new waterproof cable, which is insulated in the following manner:—Next the core is placed a layer of paper lapped on in the usual way; the paper, which is of the best quality manilla, is somewhat thicker than is ordinarily used and is impregnated before being applied to the cable. After the lapping is complete, the covering is again impregnated, and is then taped. Over the tape is placed a layer of a waterproof material to which the name of Dialite has been given, the composition of which it is not desired to disclose, although it is believed to be durable. The Dialite is lapped with tape in the same manner as a rubber-covered cable, and is then vulcanised in steam. After vulcanisation is complete, the cable is finished with braiding treated with preservative compound in the usual way.

Mr. C. H. Wordingham, the well-known Manchester engineer, has made some tests upon a cable of the following dimensions:—

Diameter of core over outside of strands ...	0·322 inch.
Diameter over outside of paper	0·461 „
Diameter over outside of tape	0·482 „
Diameter over Dialite	0·671 „
Diameter of finished cable outside braiding...	0·816 „

The above figures give a thickness of wall of 0·069 in. for the paper and 0·094 in. for the Dialite.

The length of cable tested was stated to be 220 yards, and the core was composed of 19 strands of No. 16 S.W.G.

The insulation resistance was measured by a battery giving about 600 volts, and the insulation resistance at the end of 1, 2 and 3 minutes' electrification respectively was found to be as follows, the temperature of the water in which the cable was immersed being 42° F.:—

	Insulation resistance Of length.	Per mile.
After 1 minute's electrification	1,265 megs.	158 megs.
After 2 minutes' „	1,555 „	194 „
After 3 „ „	1,707 „	213 „

The capacity was determined, and found to be 0·0988 microfarad for the lengths, corresponding to 0·79 microfarad per mile, the temperature of the water remaining the same.

An alternating pressure of 5,000 volts, having a frequency of about 80 periods per second, was applied to the whole length for half an hour without the cable showing any signs of breaking down. The pressure was next raised until the cable broke down, the dielectric being pierced at a pressure between 18,000 and 19,000 volts.

A piece of the same length of cable, which had been under water for several days, and for 24 hours immediately before the test was made, and to which a pressure of between 18,000 and 19,000 volts had been applied as described in the last test, was cut off from one end, and was bent three times in each direction, making six bendings in all, round a drum about 7½ in. diameter. The drum was actually a tapering one, tapering from 7¾ in. to 7⅛ in. diameter. After bending, the length was immersed in water, except for about a foot at each end, and an alternating pressure, having a periodicity of about 80 periods per second, was applied to it. The pressure was raised to rather over 14,000 volts, and was maintained at this value for three minutes, when the length broke down at a point about 4 ft. 6 in. from one end.

A test which Mr. Wordingham made of a wire insulated entirely with Dialite showed this material to have a high dielectric strength as well as considerable insulation resistance.

Mr. Wordingham draws attention to the fact that the Dialite covering is thoroughly waterproof; this is shown not only by the tests described having been carried out after prolonged immersion in water, but still more conclusively by the material having been vulcanised in steam with the paper covering within it. Had it been at all pervious to moisture, the steam must have entered the paper and destroyed its insulation resistance.

A cable insulated in the manner described has, in Mr. Wordingham's opinion, the advantages over a lead-covered cable of—

1. Being unaffected by electrolysis.

2. Having an insulating surface so that it cannot transmit a leak to other cables, nor carry currents that may cause the covering to fuse.

3. It is very much lighter, thus being easier and cheaper to handle.

4. It is much less costly.

In those cases in which the mechanical protection afforded by a lead covering is of importance, the cable insulated as above described can be lead-covered, the braiding then, of course, being omitted. When this is done, it possesses the advantage over an ordinary lead-covered cable that if there be any defect, such as a pin-hole or flaw in the lead, or if the lead be damaged so as to admit moisture, the insulation of the cable is unaffected, since the Dialite prevents the moisture gaining access to the paper.

He concludes that the invention is a useful one, and that ordinary lead-covered paper cables are greatly improved by the addition of a layer of Dialite between the paper and the lead, while, in many cases, where the conditions are suitable, Dialite might with advantage be substituted for lead.

Station engineers will certainly feel interested in the latest type of cable produced by the St. Helens Company, and many of them will no doubt wish to put the material to the practical test of constant use and lapse of time.

WORKSOP ELECTRICITY WORKS.

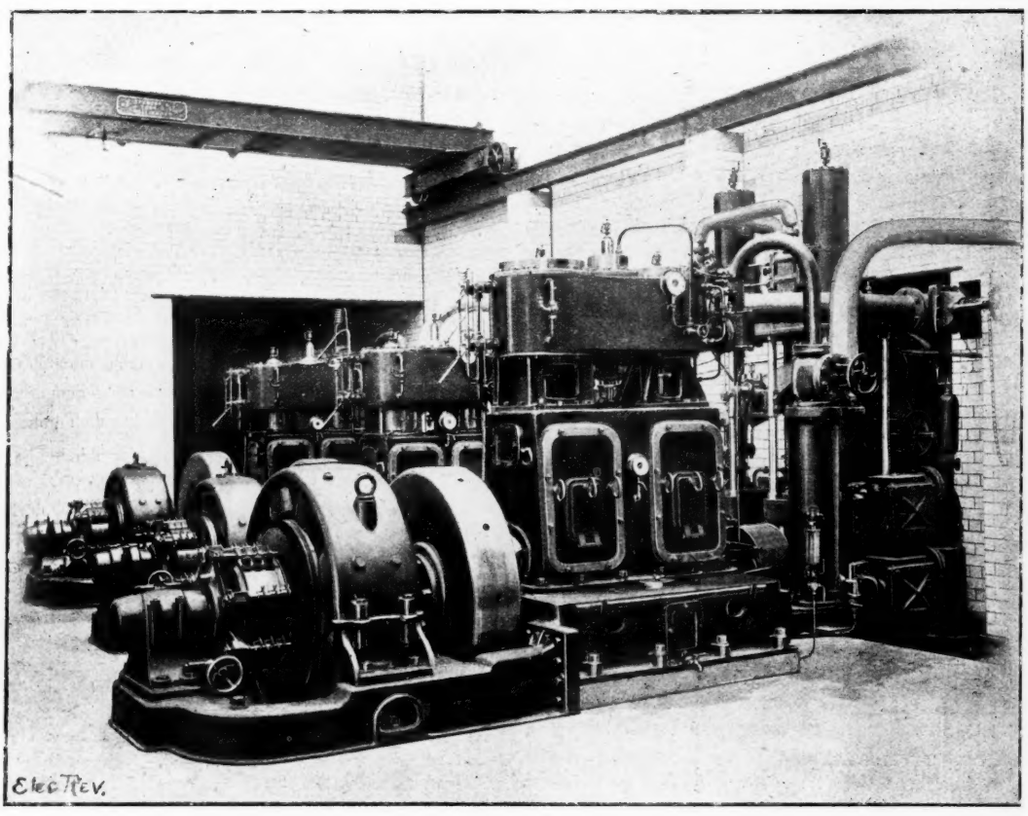
THE opening of the electric light station of the above town took place last autumn, this being the first town in Nottinghamshire—excluding Nottingham itself—to adopt electricity as an illuminant. Mr. A. B. Mountain, M.I.E.E., acting in the capacity of consulting engineer, was responsible for the arrangement of the whole station, and it was carried out in accordance with his designs.

The capacity of plant at present installed is 350 KW., with sufficient space available under the existing roof, both in engine and boiler house, to add another 300 KW. The three-wire system has been adopted with 440 volts between the outers, and with the middle wire earthed.

The building was erected, together with the shaft, by Mr. W. Hall, of Worksop. The shaft is 150 ft. in height, and 5 ft. 6 in. in internal diameter, a ventilating space being left between the inner core and the shaft proper, access to which is provided by means of doors let into the brickwork. The main building comprises the engineer's office and leading-in way fronting the road, the floor above this being occupied by the accumulators. Immediately behind them is the engine room, 56 ft. long × 28 ft. broad, with a height of 22 ft. to the bottom of the roof trusses. This is exceedingly well lit by skylights and windows during the day, and by means of two arc and various glow lamps at night. The effect is further heightened by white glazed bricks, which are used entirely for the walls. The further end (towards the river) is at present filled in by a temporary wooden structure, which may easily be removed, when necessary, for extensions.

For erecting purposes and general work, a 5-ton hand-driven crane, supplied by Messrs. Spencer, of Hollinwood, spans the entire engine house.

On the boiler house side of the engine room stands the boiler feed pump and condensing plant, both installed by Messrs. J. Carter & Son, of Stalybridge. The former has a capacity of 2,000 gallons per hour—with Buffalo injector fitted close at hand as a stand-by—and the latter is capable of dealing with 18,000 lbs. of steam per hour; it will be seen, therefore, that it is amply large enough for the existing engine plant. The accompanying illustration clearly indicates the design of the pumps.



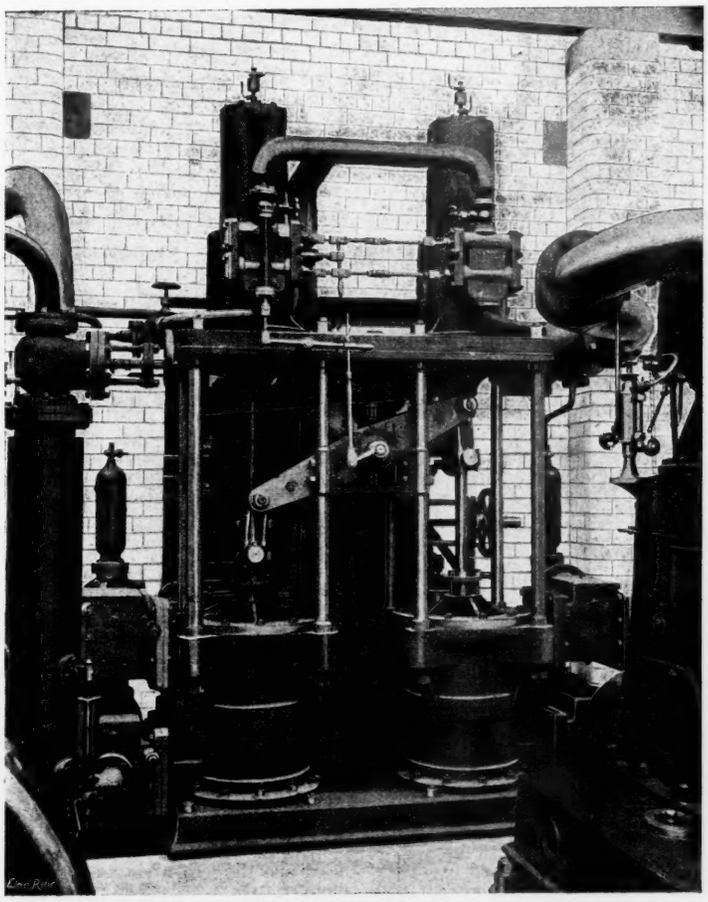
WORKSOP.—GENERATING PLANT.

In connection with the boiler feed pump and condensing plant, it will be observed, upon referring to the illustrations, that the valve gear is of Messrs. J. P. Hall & Son's special design, the adoption of which results in a low steam con-

sumption very rarely attained by auxiliary plant of this description.

In the boiler house are two Lancashire boilers 8 ft. in diameter and 30 ft. long, rated at 300 H.P. each, having a working pressure of 125 lbs. per sq. in., with sufficient space under the existing roof to allow the present boiler plant to be doubled. The boilers are of Messrs. Danks's manufacture, with all fittings of the Hopkinson standard type, including dead-weight safety valve and low-water alarm.

The switchboard, constructed by Messrs. Clayton & Co., of Huddersfield, in accordance with their standard design, is of enamelled slate with iron framework. The centre panel controls the balancer set, and is further provided with voltmeters and multiple-contact voltmeter switches, to which the distributor and feeder pilot wires are brought. A recording ammeter is also placed at the bottom of the panel, connected between the neutral bus bar and an earth plate, in order to indicate the current passing through the earth to the neutral bus bar. To this instrument (the range of which is 20 amperes) is attached a device whereby, should the current exceed this amount, a fuse is blown, and the ammeter is short-circuited automatically, to prevent its being damaged.



Worksop.—Hall Differential Pumps.

Upon the upper part of the two next panels the booster switches and regulators are placed, the lower portions of the same panels being devoted to battery regulators and switches. The remaining panels control the generators, and also carry switches, fuses, and instruments for the four distributors and their feeders.

The accumulators, to which previous reference has been made, were installed by the E.P.S. Company; the plates are of their K.W.S. type, there being 11 plates per cell. The rating is 180 ampere-hours, and there are 240 cells, subdivided as follows:—212 working, 10 on each end for regulating, and 8 reserve cells, which are periodically interchanged with others. The function of the battery is only to help to balance the load.

An economiser of Messrs. Green's well-known pattern is included with the plant, the scrapers of which are driven by a 3-H.P. "Witting" semi-enclosed motor.

The whole of the generating plant has been supplied by Messrs. Witting Bros., Electrical Engineers and Contractors, Limited, of London, and comprises: — Two 100-KW. steam dynamos, one 150-KW. steam dynamo, together with a balancer booster set with outputs as stated below.

Each of the 100-KW. dynamos is direct coupled to a "Scott & Mountain" high-speed double-acting engine, with forced lubrication, running at a speed of 450 revolutions per minute. Each engine is provided with a steam separator and all usual fittings, an extra heavy flywheel being employed so that it may be used in the future for traction purposes.

The 100-KW. dynamos are six-polar, each with a bar wound slotted armature and commutator of hard drawn copper. Each brush rod carries three carbon brushes held on the commutator by the "reaction" type of brush holder. The machines give any output between no load and 20 per cent. overload perfectly sparklessly without shifting the brushes.

The poles are of cast-steel, in one piece with the pole shoes, the bolts which hold them in position passing right through the field ring. In accordance with Messrs. Witting's standard practice for this size of plant, the beds are furnished with faced seatings bolting to similar seatings on the engine bed, there being an outboard bearing for the dynamo. This bearing is of the self-aligning, self-lubricating type, the lubrication being performed by means of ring oilers dipping into an oil well of extra large capacity, provided with draw-off cock and gauge glass.

The steam consumption per kilowatt-hour at full load actually obtained with the above machine on test was 28·6 lbs. running condensing.

The 150-KW. machine is of similar construction, with the exception that the pole tips are laminated and the number of poles increased to eight, the set running at a speed of 400 revolutions per minute.

The steam consumption per kilowatt-hour at full load actually obtained with the above machine on test was 25·8 lbs. running condensing. The general design of these machines may be seen from the foregoing illustration.

With regard to the balancer booster set, this consists of four coupled machines, also of Messrs. Witting's standard type, running at a speed of 1,200 revolutions per minute. The balancers are each capable of dealing with a current of 30 amperes at 220 volts, and the boosters are arranged to boost from 0—80 volts with a current of 70 amperes. The connections to these sets are so arranged that either booster may be used by itself, or the boost may be varied on either at will without interfering with the other.

The whole of the street cables, junction boxes, &c., have been supplied and laid by the British Insulated Wire Company, this work being carried out in a most creditable manner, and strictly in accordance with their standard practice. The arc lamp-posts were also supplied by this firm, the lamps themselves being of the "Stewart" type.

A new departure in municipal work, which we believe was due to Mr. A. B. Mountain, was made in this town, by supplying the first fortnight's lighting free, the official

connection being established and regular supply undertaken on October 1st.

The whole of the work in connection with the above has been carried out under the supervision of Mr. J. P. Crowther, the resident engineer, assisted by Mr. Heron.

In conclusion, we wish to thank both Mr. Mountain and Mr. Crowther for their courtesy in affording us facilities for obtaining the data and photographs used in the preparation of this article.

A NEW SYNCHRONISM INDICATOR FOR ALTERNATORS.*

By FRED. P. WOODBURY.

When throwing large alternate current generators in multiple, it is desirable to have them as near perfectly in phase as possible to prevent the welding of the switch contacts that is likely to occur if the machines are put together slightly out of step.

Mr. Paul M. Lincoln, resident electrician for the Niagara Falls Power Company, has devised an instrument that not only indicates exactly the synchronism of two machines to be paralleled, but also shows the relative speeds and the constantly varying phase difference between the machines during the process of bringing them into synchronism. The instrument is mounted upon a frame that resembles a fan motor, with a dial and pointer replacing the fan.

Fig. 1 shows a front view of the instrument, with the hand at the point of synchronism. Fig. 2 is a back view, with the rotor, one bearing and pointer removed and lying at the right. The lamp at the top is used for a non-inductive resistance; an inductance coil is placed in the base. A phase of each of the machines to be paralleled is connected to the four binding posts upon the base.

Both rotor and stator are built of laminated iron. The stator is bipolar, and has winding with a sufficient number of turns to produce a strong magnetic field. The rotor is a drum-wound armature having upon it two coils set at right angles to each other. Three slip rings are fitted upon the shaft that connect the coils to the external circuits through suitable brushes. The shaft rests in ball bearings.

In fig. 3 F¹ is the stator with the coil, F, upon it. G and H are the two rotor coils that revolve in the field of F¹. The R's are the slip rings and brushes. An end of each of the coils, G and H, is connected to the middle slip ring, and the remaining ends of the coils are connected to the other two

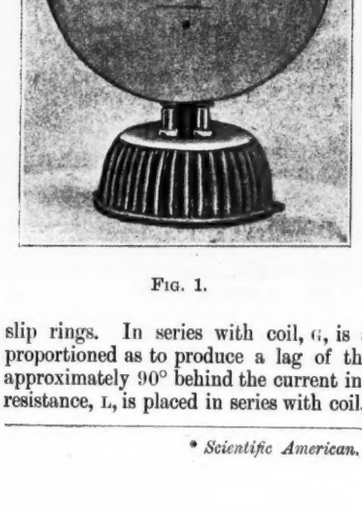


Fig. 1.

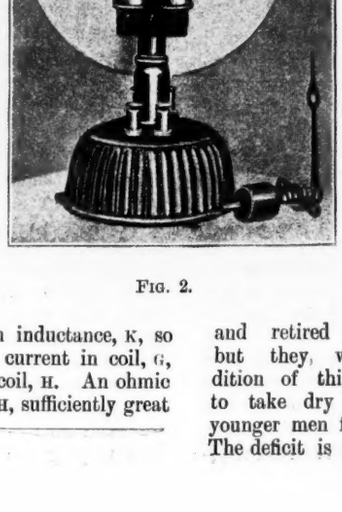


Fig. 2.

slip rings. In series with coil, G, is an inductance, K, so proportioned as to produce a lag of the current in coil, G, approximately 90° behind the current in coil, H. An ohmic resistance, L, is placed in series with coil, H, sufficiently great to make the currents in the two coils equal. The leads from K and L then unite.

To use the synchronism indicator the leads from the stator are put upon a phrase of one of the machines to be paralleled, and the rotor leads connect with the corresponding phase of the other machine.

When the machines are in synchronism, coil G will stand at right angles to the field of F¹, and when the machines are in opposition, coil G will still be at right angles to F¹, having

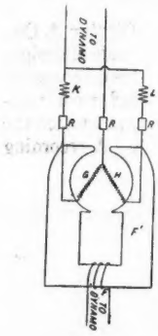


Fig. 3.

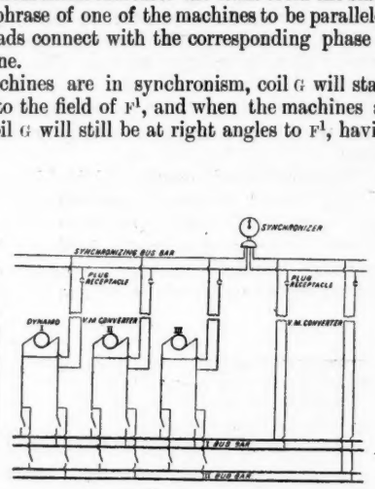


Fig. 4.

turned 180°; thus the rotor will take up intermediate positions between these two extremes corresponding to the constantly varying phase relations of the two machines, and the pointer, moving over the dial, will indicate to the attendant the necessary procedure to bring the machines into synchronism.

Fig. 4 is a diagram of connections of the synchroniser used on the switchboard of the Niagara Falls Power Company. The phase relation between either machine and the power bus bar may be found by merely inserting the proper dynamo and bus bar plugs. At the request of some of his professional friends, Mr. Lincoln has made several instruments in the power company's workshop.

* *Scientific American.*

ENGINEER OFFICERS FOR THE FLEET.

By ROLLO APPLEYARD, A.M.Inst.C.E.

It is indeed difficult to comprehend the present attitude of the Admiralty, and of the British peoples, here and beyond the seas, in regard to the question of obtaining, training, and maintaining men and officers sufficient in numbers, and adequate in qualifications, for the engineering duties of our fleet. On a very moderate estimate there is, in the engineer branch, an all-round deficit of 40 per cent., corresponding to a shortage of at least 600 engineer officers, R.N., 1,000 artificers, and 16,000 stokers, which would have to be made good before we could put our fleet to sea with anything but skeleton crews. The assumption appears to be that in the event of naval war, full complements could suddenly be recruited, officers trained, artificers collected, stokers got together, all for immediate service anywhere. There is a vain belief that the Royal Naval Reserve would fill the gaps. But the truth is that, as regards the engineer branch, our reserve forces are insufficient to man even the reserve merchant cruisers—we have thus no real reserve of engineer officers, artificers, or stokers for the fleet proper. Pensioners and retired naval officers might be furbished up, but they would scarcely affect the present condition of things, except in so far as they are able to take dry billets ashore, thus setting free a few younger men from the dockyards for active service afloat. The deficit is real, and cannot be denied; it is a standing

menace to our existence as an Empire; its reality is not yet appreciated, and it is not yet provided against by the Admiralty. Whenever the question of the engineering *personnel* of the fleet came up last year for discussion in the House of Commons, it was adroitly parried by the Government, and postponed indefinitely, so that the session passed without an explanation concerning it. In July, a deputation was received by Lord Selborne, and stated the case in language that was as concise as it was impressive, but the deputation was unable to obtain the slightest confession of weakness, or any promise of improvement from the Admiralty.

As regards the average Briton, perhaps it is easy to understand a certain lack of interest in such a question. After all, it is a technical matter, to be dealt with by experts accustomed to engineering problems, and by naval experts; the average householder views it in simple faith, and a strong hope that the Admiralty are doing what is necessary. But to the average engineer, who knows the meaning of the deficit, and who dwells upon the fact that the Admiralty Board has not a single engineer officer in its constitution, the matter takes a new light, and he begins to wonder whether it is not time that a change was effected. Even supposing that stokers and artificers could be got in sufficient numbers at a moment of crisis, every engineer knows that it would be impossible to obtain engineer officers ready made, a *corps d'élite* trained to govern the countless complexities of a battleship in action. The time has now arrived for engineers generally to tackle a question which the despotic Admiralty and the untutored Briton alike fail to grasp, the one because they are etiolated by tradition, and the other because he cannot learn war except by examples.

It is not intended here to restate the case for engineer officers R.N.; that has been frequently done during the past 20 years. Their disproportionalities of rank as compared to deck officers, and their classification by Admiralty Regulations as "civil" "non-combatants," have been often dealt with and denounced in the Electrical Review. But we must draw attention to some recent evidence that deserves the attention of every British engineer. To begin with, it is apparent that the Admiralty are, by force of circumstances, brought face to face with the problem attending the deficit of officers for the engineer branch of the Navy. They are advertising, but so unpopular is the engineering branch that the number of applicants is ridiculously small. They have lowered the standard of the entrance examination into the Royal Naval Engineering School at Keyham, and have even invented a system of "direct entry," but still the vacancies cannot be filled. Thus, according to Sir Fortescue Flannery, for 200 vacancies advertised last Christmas year only nine candidates responded, and so poor was their work at the examination, notwithstanding the lowering of the standard, that only three were able to pass. This farce is being repeated at all examinations, and meanwhile the number of our fighting ships is increasing; gaps have to be filled by irresponsible substitutes, and the honour, welfare, and safety of our fleet is being entrusted to unqualified subordinates. The missing *Condor*, for instance, carried no qualified engineer officer, R.N.

To the suggestion that the Board of Admiralty is not properly representative of the engineer branch of the Navy, Lord Selborne replies that the Board has not been, and never will be, a collection of the Heads of Departments, but that it consists of the Lord High Admiral or a number of gentlemen selected by the Crown. The fact is, we care little as to the constitution of that Board, always provided that it is efficient, and that it possesses enough knowlege of men and of mechanism to secure to us success in war at minimum adequate expenditure. Such defects as we have alluded to, permitted in the *personnel* of the engineer branch of the navy, in time of peace, are admitted by such experts as Sir John Hopkins, Admiral Fitzgerald, Admiral Henderson, Sir Edward Freemantle, Sir Fortescue Flannery, Mr. John Corry, Sir Charles Palmer, and by every engineer officer in the service to be a grave element of risk; and the weight of their testimony is the strongest evidence against the present constitutional form of the Board of Admiralty. We want the keenest intellects on that Board. The education of the qualified professional engineer officer R.N. is of higher order than that of any officer in either of the Services, and it seems reasonable to suppose that the presence of one or two of these gentlemen on the Board would greatly enhance the usefulness of that august body.

Lord Selborne says further, that "the engineer branch have already the means of representing their case and of putting forward their points"; from which we are led to suppose that he considers that any addition to the Board itself from that branch is superfluous. A full account of the reception accorded to the deputation is given in an appendix to a paper by Mr. D. B. Morison, read before the North-East Coast Institution of Engineers and Shipbuilders; and anybody who follows that account and considers the remarks of Lord Selborne to the deputation, can judge for himself of the utility or otherwise of engineer officers "representing their case" or "putting forward their points" to such despotic potentates.

The deficit, the deputation, the dearth of entries at Keyham, and the growing discontent among engineer officers, have combined to force the Admiralty to consider the possibility of a rearrangement of the duties of deck officers and of engineer officers respectively. Their proposition is, that gunnery lieutenants are to be responsible for all gun mountings as well as for hydraulic fittings and connections with the guns, and for all hydraulically-worked machines at present used for serving the guns, but not for the pumping engines. Torpedo lieutenants would have charge of, and be responsible for, the care and maintenance of all dynamos, electric motors, electric lighting, Whitehead torpedoes and discharges. So much for deck officers. Engineer officers, by the same proposition, would have charge of all steam-driving machinery, and would be responsible for the maintenance and supply of water, electricity or air, at the required pressures. And when dynamos are coupled to steam engines they would be responsible for running them, and for the supply of electricity at the proper voltage at the terminals. What it comes to is that all these officers, gunnery, torpedo, and engineer, are to have in future engineering duties; but, according to the proposal of the Admiralty, the duties of the engineer officer proper are, in effect, to be restricted to within the engine room and boiler room bulk-heads. There is, however, no proposal to rationalise, simultaneously, the rank and status of these officers; gunnery and torpedo officers are to continue as executive (military) units, and engineer officers are to remain classified as "civil" "non-combatants." In other words, gunnery and torpedo officers will carry the titles "lieutenant," and so forth, with the concomitant distinguished pretentions; while the engineer officers proper, whose education, efficiency, patriotism, and pluck, is admittedly second to none in either of the Services, will still be known as "Mr.," or at best as "Esq.," whereby they are constantly to be reminded that they are unappreciated by their country and despised by the Admiralty.

It is to be observed that the tactics followed by the Government last year in excluding this question as far as possible from discussion in the House, are in a fair way to be repeated the Session. The statement of the First Lord of the Admiralty explanatory of the Navy Estimates 1902-1903, contains not a single word on this matter. He admits that the development of the peace administration must be on such lines as make for efficient war administration, and yet passes over the 40 per cent. deficit in the engineer branch in silence, and asks for just enough men and officers to form skeleton complements for ships now under construction. There are, however, some hopeful passages in his statement which we most sincerely trust may be translated as indicative of an endeavour on the part of Lord Selborne to do the right thing in this matter. He reminds us that as oars gave place to sails, so sails have yielded to engines, and timber to metal. The training of the seamen should, therefore, he says, "be directed towards a knowledge of the structure and machinery of a modern man-of-war, and towards capacity and handiness to deal with and repair it." If this is true for the men it is true for the officers, and for the Admiralty Board itself, and it implies that the education and training of all in this class must be revised so as to include a sound knowledge of engineering.

When, however, we turn to that part of the statement in which he sets forth the new scheme of training that is to render gunnery and torpedo officers capable of taking over

the engineering duties, to which reference is made above, it is not clear that they are to receive an adequate mechanical training. We note with satisfaction that more time is to be given to the study of electricity and its practical application, but we should like to feel assured that the course of instruction of these men, to whom, prospectively, is to be given the care of a large proportion of machinery, will include also a thorough grounding in machine construction, steam, and hydraulics.

To the present writer the weakness of the scheme seems to lie in the invidious distinction drawn by the Admiralty between the gunnery and torpedo branches and the engineer branch. *Quis separabit?* On the other hand, it must be admitted that to the American system of unification of these branches there are grave objections. For several years past the writer has studied this matter, and has suggested an alternative to meet the case. Briefly, the suggestion is to found a Royal Naval University, a central institution, which could, if necessary, have auxiliary colleges situated in the Colonies or elsewhere, preferably at the dockyards. The new R.N. College at Dartmouth could easily be adapted to the purpose. Into this university all prospective gunnery, torpedo, and engineer officers would be admitted by common entry, and the successful candidates would for, say, the first two or three years, take their engineering course in common, either ashore or afloat. This would have the advantage of economy in professoriates, it would ensure the benefits of *camaraderie* to the cadets, with parallelism of rank, and would engender a much-needed spirit of healthy competition amongst them. At the end of the second or third year a process of differentiation would have to begin, for it is impossible to ensure efficiency in working modern mechanism without realising that perfection depends upon the efforts of specialists. This process, the object of which would be to train prospective specialists for torpedo work, gunnery, and the like, could take the form of judicious selection by examination from amongst the second or third year men, moderated as far as possible by the natural aptitude and inclination of the cadets, so that as regards the mechanism of the ship they would learn something of everything, and everything of something. At a pinch, in action, each could thus take the other's place effectively, if not so well. It is, of course, obvious that the studies could not all be taken at Dartmouth, but that could be the central Royal Naval University, the *alma mater* of the mechanician officers of the fleet, with branches at the dockyard at, say, Devonport and Whale Island. The writer is confident that such an organisation, while settling once for all the differences of rank, would ensure honour and popularity to the engineer branch of our Navy, so that there would be no lack of applicants for commissions in that branch, and the Admiralty would be spared the ignominious task of advertising for them.

DESIGNING OF CONTINUOUS CURRENT DYNAMOS.

By AUBREY CLAYTON, Designer of Continuous Current Machinery to Elektriska Aktiebolaget Magnet, Sweden.

I HAVE followed with considerable interest the papers read at the Glasgow Congress and the discussion resulting therefrom. I cannot, however, agree with Mr. Rankin Kennedy, when he says in the issue of the ELECTRICAL REVIEW for November 20th, that the subject of commutation has been thoroughly thrashed out years ago. On the contrary, the problem is yet with us, and a glimpse into the test room of the best and most prominent firms, showing the number of failures that occur in this line, would convince anyone of the fact; hence, any light that can be thrown on the subject, especially by men of such practical experience as Mr. Hobart and Mr. Mavor, must naturally be welcome.

Referring to Mr. Kennedy's rule that the ratio $\frac{B}{C}$ should not be less than 18,000 to 1 as expressed in C.G.S. units, I cannot see any meaning or value in it whatever. Had C been multiplied by the amperes in winding, giving a ratio of armature ampere-turns, per pair of poles or per pole, to flux, it would have some interest and value, which if not directly bearing on the sparking question has at least something to do with the regulative qualities of the machine. The strength of armature reaction cannot be expressed by the mere turns on the armature, for if one has a coil of 10 turns with 100 amperes flowing in it, the magnetic result will be the same as with 100 turns, and 10 amperes, yet Mr. Kennedy's rule would show a 10 to 1 difference.

To illustrate my meaning, take, for example, a 4-pole machine of 110 volts, 5 H.P. and 1,200 r.p.m. The armature of such a machine has 320 total turns, or $\frac{320}{4} = 80$ turns *between the centre of two poles* = C. The total flux, B, for one pair of poles is 900,000 C.G.S. lines, hence

$$\text{ratio } \frac{B}{C} = \frac{900{,}000}{80} = 11{,}200 \text{ to } 1.$$

Now, if the same armature be wound for 500 volts, employing 1,600 turns on the armature and having the same speed and flux, C will be $\frac{1{,}600}{4} = 400$.

B, as before, = 900,000.

$$\therefore \frac{B}{C} = \frac{900{,}000}{400} = 2{,}240 \text{ to } 1.^*$$

Had an expression of armature ampere-turns been used in the above the ratio would have been the same in both cases, or, more strictly speaking, somewhat greater in the latter case, as with the higher voltage a better insulation is required in the slots, and also with many conductors of small wire, the space factor of copper to slot becomes less, hence resulting that the 500-volt machine must be rated somewhat lower, say, 4 H.P., with as a resultant less amperes in the armature conductors. As a further example take machine No. 5 from Table XIX. of Mr. Hobart's paper; this is a 4-pole 10-KW. 550-volt machine, running at 930 r.p.m. It has a two-circuit single-winding with 585 total turns on the armature, hence

$$\frac{585}{4} = 146 \text{ turns per pole} = C.$$

The total flux, B, per pole is 1,570,000 C.G.S. lines, hence

$$\text{ratio } \frac{B}{C} = \frac{1{,}570{,}000}{146} = 10{,}750 \text{ to } 1.$$

Compare with this machine No. 9 on the same list, a 4-pole — 30 KW. — 115-volt, running at 600 r.p.m. This also has a two-circuit winding with 119 total armature turns, or $\frac{119}{4} = 29$ per pole, while the flux per pole is 2,550,000 C.G.S. lines, hence

$$\text{ratio } \frac{B}{C} = \frac{2{,}550{,}000}{29} = 88{,}000 \text{ to } 1.$$

Had some of the larger machines on the list been compared with these, there would be an even greater disparity; therefore, it will be apparent that any rule taking account merely of the armature turns to form the basis of a ratio between armature and field strengths is valueless, the figure so obtained varying as it does between extreme limits according to the voltage and size of the machine.

Most designers have some rule or other to go by, in most cases one based on their own experience, which guides them in the right proportioning of field strength to armature strength. One, which will be found very good, is the ratio of the field ampere-turns (per pole) required to drive the impressed flux across the air-gap and through the teeth, to the ampere-turns per pole at full load on the armature.

Thus, suppose a machine has 8,000 amp.-turns per field spool, and 5,000 of these are required to drive the resultant flux across the air-gap, while 900 are required to overcome the reluctance of the teeth; this machine has, say, 60 turns per pole on its armature in which winding flows a current of 100 amps., giving 60 × 100 = 6,000 amp.-

* These are not hypothetical cases, hundreds of machines have been built after this specification and are running, and have been for years, with perfect success in all parts of the country.

turns per pole on the armature. The field amp.-turns for gap and teeth divided by armature amp.-turns

$$= \frac{5,900}{6,000} = \cdot 967.$$

This, however, and any such rules or constants have, in the writer's opinion, absolutely no bearing whatever upon the commutating qualities of the machine beyond preventing distortion of the field flux by armature reaction, and hence keeping the position of the brushes fixed during alteration of the load; they, of course, determine the regulative qualities of the machine, just as in the case of alternating current generators the regulation is dependent on the relative strengths of armature and field. It is possible, however, to increase the armature strength to such a degree that no sparkless position of the brushes can be obtained. As is well known, a certain amount of counter-impressed flux is required to help the current reversal in the coils undergoing commutation, and with every movement forward of the brushes to endeavour to get this right zone of commutation the demagnetising strength of the armature is increased, by reason of its better position in respect to the impressed flux, and the field so weakened will be further distorted. For this reason it is desirable to keep the ratio value of

$$\frac{\text{Field ampere-turns for gap and teeth}}{\text{Armature ampere-turns}}$$

fairly high. If it is desired to have no shifting of the brushes it should not be less than ·7 in large machines to 1 in small sizes. Many machines, especially so-called traction generators, may be seen running in which the ratio is much less than the above, but such machines, although usually stated to require no shifting of the brushes, have a position for no load and one for full load, this being in most cases only known to the station attendants who look after the machine. It will be at once apparent from the foregoing that no such rule as 1 centimetre gap per 10,000 armature ampere-turns is required. To produce the necessary ratio a long air-gap with low density may be employed or a short one with a high density. The writer, however, believes that a short gap with high density is preferable, as in such there is less liability of the flux being distorted by reason of armature reaction than in the long gap of low density. It must not be lost sight of, however, that with a short gap of high density and highly magnetised teeth one always runs the risk of inducing large eddy currents in the pole faces if, as is most generally the case, the latter be of solid cast-steel or even of cast-iron. In small machines the length of air-gap is generally determined by these eddy currents when the pole face is not laminated, and as the magnetising energy required for machines of, say, 5 KW. down to 1 KW. comes out at approximately 3 to 7 per cent. of the total output of the machine, and of this 3 to 7 per cent. at least 2 to 5 per cent. is expended in overcoming the air-gap reluctance, considerable importance attaches to the shortening of it so far as is possible. If, however, by shortening the air-gap one increases the pole face eddy current losses, it may happen that no great gain in efficiency is obtained; on the contrary, it may easily be lowered, for after a certain minimum limit of gap has been passed these losses go up very rapidly, whereas the gain effected by diminishing the gap is only proportional to the amount it is shortened. Reasoning out from this it follows that to produce the best machine one must either employ laminated pole faces or else use partially closed slots, which eliminate these losses to a great extent, but here we are met with the difficulty of extra expense in manufacture entailed thereby; on the one hand by extra machine work required for the laminated poles, and on the other by the extra cost of hand-wound armatures necessitated by having partially closed slots against those having former-wound coil windings. With solid pole faces and open slots, short gaps can be used without incurring trouble from eddy current losses, by keeping a comparatively low density in the teeth, and having many slots of small breadth instead of a small number of broad ones. Thus with teeth measuring 10 to 12 mm. from centre of one tooth to centre of the next, and a density of 15,000 C.G.S. lines per square cm., a gap of 2·5 mm. can very well be taken. In large machines it is seldom that trouble arises from pole face losses.

An idea exists in many minds that well saturated teeth are a preventative of sparking, on the ground that the reluctance in the teeth is so increased by the high density, that little or no further flux due to self-induction of the coils undergoing commutation can be created therein. That this is most obviously erroneous, is evident, as the position of the coils at the instant of commutation is, at no load, midway between the pole tips, and at full load only just in that fringe of field required to overcome the flux due to reversal of the current. The result of having impressed flux in the teeth during the period that the coil in the adjacent slot is undergoing commutaion, is at once apparent in a display of fireworks, if the brushes be moved forward under the pole face, thus bringing the zone of commutation into an impressed field, while the machine is under load.

That having the teeth highly magnetised does apparently help to improve commutation is undoubtedly the case, but the reason may be found in that by so doing, one prevents distortion of the impressed flux, as previously explained in

$$\frac{\text{Field amp.-turns for gap and teeth}}{\text{Armature amp.-turns}}.$$

The mere fact of the teeth themselves being near saturation point has nothing to do with the matter, and this can readily be proved by taking a machine in which the ratio of field amp.-turns for gap *alone* to armature amp.-turns is high, running it as a generator and weakening the field so as to bring the voltage down while maintaining the same armature *ampere* output, thus decreasing the tooth densities while having the same amount of current to commutate. If the ratio of field amp.-turns for gap to armature amp.-turns be fairly high, it will be surprising how far one can come down on the saturation curve without sparking.

The cost of a machine for a given output and speed can be greatly reduced by using a high strength of armature as compared with field, and hence the utmost importance attaches to being able to just use the maximum without incurring any risk of bad commutation. It is all very well to speak of *putting enough stuff in*, but in these days of keen competition the maker, who endeavours to keep up the quality of his machines by an indiscriminate liberality in the use of material, will find himself badly left. As an example of what can be done by judicious designing may be mentioned the case of a machine, the specification of which the writer went into and revised on the lines of having the maximum permissible armature strength as set forth herewith, the only alterations made being an increase of the armature diameter and a shortening of the poles (the machine was of multipolar type). The result was that with the same amount of material the machine built after the revised specification gave 20 per cent. more output, ran cooler and had 2·5 per cent. higher efficiency than before, while the commutation was perfect. This example is the more striking as the original was a well designed modern machine and quite up to date, having been designed and built in 1901.

ELECTRICAL COMPANIES AND RESPONSIBILITY FOR ACCIDENTS.

[By Our Legal Contributor.]

The recent disastrous accidents at Liverpool, in which several passengers on an electric railway lost their lives, must naturally turn the attention of all who are interested in the progress of electricity to the question of the legal responsibility for accidents. The loss occasioned to an electric railway or tramway company by payment of damages to unfortunate sufferers is as nought when compared to the loss of prestige which follows in the wake of a fatal accident. To old-fashioned railway companies, whose claim to the public confidence is well established, a collision or other catastrophe is but of passing moment; but to electric railways, which are hardly out of their "teens," permanent injury and disaster may follow.

To the engineer, however, must be left the task of so constructing his railway or tramway that accidents cannot occur; it is the part of the lawyer to point out the extent of the company's liability for the more immediate consequences of an accident.

A short survey of the law relating to the legal liability of electric railway, tramway, and lighting companies for the different kinds of accidents which may from time to time occur, may, therefore, be found useful. As the application of electricity for commercial purposes is of comparatively recent date, it is not possible to cite a host of authorities from the law reports. Nevertheless, the more important cases which have arisen in the past 20 years have generally been dealt with in the columns of the REVIEW, while the principles applicable in such cases can be deduced from a consideration of the bitter experiences of railway, horse tramway, and gas companies.

With regard to electric railways, their position is very similar to that of an ordinary railway. Subject to the provisions of the private Act under which they work, they can be held liable in damages to the persons who are injured in any accident which arises through the default or neglect of any of the company's servants. Negligence on the part of a signalman or of a platelayer may, therefore, involve a serious loss to the company. It is obvious, however, that the tube railways, which already confer such a boon upon Londoners, are free from many of the sources of danger which involve risk to passengers above ground. Platforms of the same level as the carriage floor, the maintenance of traffic on the loop system, the presence of a careful official at every door and elevator, reduce the element of danger to a minimum. The stoppage of a train in the tube, however, and the consequent necessity of conducting passengers through a dark passage between live conductors may expose them to imminent risk. In such circumstances it is probable that the company would be held responsible for all injuries and damages which might ensue.

Tramway companies next demand attention. Owing to the fact that the most important part of their business is carried on in crowded thoroughfares, these bodies are continually exposed to risk of accidents which may involve payment of heavy damages. In what are commonly known as "running-down" cases the ordinary rule of law, which bids the Court to have regard to the contributory negligence of the party injured, may sometimes serve to protect the company.

The liability of tramway companies for accidents occasioned during the construction and working of their system is clearly enunciated in Sec. 55 of the Tramways Act, 1870, which provides that the promoters or lessees, as the case may be, shall be answerable for all accidents, damages, and injuries happening through their acts or defaults, or through the act or default of any person in their employment by reason or in consequence of any of their works or carriages, and shall save harmless all road and other authorities, companies, or bodies, collectively and individually, and their officers and servants from all damages and costs in respect of such accidents, damages and injuries.

This section is incorporated with every private tramway Act, and although it forms part of a statute which was passed when electric trams were not thought of, its provisions extend to such companies.

It is obvious that "short-circuits" from the trolley wire are a fruitful source of accidents, but if it can be shown that the short-circuit was caused by the wire of a telephone company falling across the trolley wire, the tramway company are not liable. In Bedworth & Son *v.* the National Telephone Company * an action was brought against the company for the price of a horse killed by an electric shock. It appeared that a broken telephone wire which fell upon the horse short-circuited a trolley wire belonging to the South Staffordshire Tramway Company, who were joined as defendants to the action. The County Court Judge held that the telephone company were guilty of a trespass in allowing their wire to touch that of the tramway company, and held them responsible in damages.

Reference to the American Law Reports furnishes a number of cases in which the liability of electric tramway companies for street accidents has been considered. Thus it was decided that a street railway company was not chargeable with negligence where its car was in perfect order and condition, suitably equipped, and operated with the use of proper signals, at a lawful rate of speed, by a motorman who kept a sharp look out, but was unable to stop the car in time to prevent a collision with the vehicle of one who suddenly drove upon the track [Cawley *v.* La Crosse, City R. Co., 77 N.W. 179, 101 Wis. 145]. The principle here laid down would probably be adopted in our own Courts, due regard being had to the fact that, short of stopping altogether, the "motorman" has no way of avoiding a collision. The driver of a vehicle, on the other hand, can effect a lateral escape from a collision. How far the tramway company has a "paramount" right to use the space between the tracks has not been decided in this country. In America, however, there is authority for saying that a driver may drive his carriage in the street car tracks if he takes due care to avoid an undue interference with the superior rights of the company, and to avoid a collision, and while so driving is entitled to protection against such a negligent operation of street cars as will inevitably lead to his injury [North Chicago Street R. Co. *v.* Zeigir, 78 Ill. App. 463]; and in the case of Goldrick *v.* Union R. Co. [37 Atl. 635], it was decided that a street-railway company owes to those travelling in the streets the duty of exercising due care in the operation of its cars not to injure them, notwithstanding its paramount right to the space between the tracks.

The laying or repairing of a tramway track involves the uprooting of streets. When operations of this kind are being carried on, it is necessary for the company to fence off such parts of the road as are under treatment, and to provide such lamps, &c., at night time as are necessary to prevent any risk of danger to those who are using the roadway. Provisions to this effect are inserted in every statute under which a tramway commences its undertaking; and even in the absence of any clause providing that they shall be liable, an Act of Parliament confers no implied right upon the company to create a nuisance or carry out their works in such a manner as to be a source of danger to the public. Moreover, the company cannot escape responsibility by entrusting the performance of such works to a contractor.

Fortunately for those who use the highways in this country where electric tramways are in operation, the strength and stability of the poles in use is such that the risk of their falling and causing disaster is very small indeed. It is not necessary, therefore, to deal with the consequences of their accidental fall.

As manufacturers of a "commodity"—if electricity can be properly so called—which may escape and do damage to lives and property, tramway companies (and the same observation applies to electric lighting companies) are exposed to common law risks.

On the well-known legal principle that applies to a man who brings a dangerous commodity on to his own land or otherwise deals with anything which in escaping may cause damage to other persons, such companies may be held liable for injuries occasioned to a telephone company by the passage of powerful currents along cables in the neighbourhood of telephone wires, and the consequent disturbance of the telephone system. This point was decided in the National Telephone Company *v.* Baker, where it was alleged and proved by the plaintiffs that their telephone system in Leeds had been seriously interfered with by induced currents from neighbouring cables.* Owing to the insertion of protecting clauses in recent private Acts and provisional orders there is now very little danger of future trouble from this source; but, as we have pointed out, the right to compensation depends not upon the existence of a protective clause, but upon an early principle of the common law.

With regard to electric lighting companies, the conditions under which their business is carried on render them even less exposed to actions for damages than the two classes above considered. Once their mains are successfully laid, and interference with the streets is no longer necessary, their liabilities to the public, as represented by their consumers, become for the most part contractual. Cases have arisen, however, in which the undue exercise of powers, or the faulty execution of the work which they are authorised to carry out, has given rise to actions for damages.

As to the relationship of company and consumer, it is obvious that damage caused by a fire started by a short-circuit on the consumer's premises may be laid to the company's account, if it be shown that the short-circuit in

* The ELECTRICAL REVIEW, February 25th, 1898, p 601.

* Nevertheless, the plaintiffs were non-suited.—EDS.

question was occasioned by the want of a fuse for the insertion of which the company were responsible. Negligence of the company's workmen in and about the consumer's premises may also mulct the company in damages.

Accidents are sometimes caused by explosion of gas in street boxes, and the attempt is made to prove that ignition was due to sparking from electric cables. We are not aware of any case in which an electric company has been fixed with liability in this way. In a case which was heard by Mr. Justice Day and a special jury at the Bristol Assizes, on February 27th, 1901, an action was brought to recover damages for injury caused by an explosion of gas. The accident took place at a spot where, in 1899, an electric tramway company had opened up the road for the purpose of laying an electric cable. The jury found a verdict for the plaintiff, with damages £200, but the question of the tramway company's liability does not seem to have been discussed, although it was proved that at the time when the works were in progress, there was a strong smell of gas in the trenches.

Seeing that the primary cause of any such disaster is the escape of gas, it is not likely that an electric supply company would ever be held entirely to blame for injuries caused by an explosion.

With regard to damage caused by the electrolytic action of escaping currents on neighbouring gas and water pipes, this is now generally provided for in the provisional order under which the lighting company carry out their undertaking. By a clause, which is common form in all such orders, the company is made liable to all gas and water companies in respect of all damages which can be proved to have arisen from this source.

With respect to overhead wires which are used in some districts for the purpose of transmitting currents at high pressure, the precautions usually taken prevent any risk of accident. It is to be observed, however, that such wires can only be suspended over private property with the consent of the owner of that property, and it is probable that the agreement made between the company and the land owner will provide for the consequences of such accident. Electric cables can only be suspended above ground in accordance with the rules and regulations laid down by the Board of Trade, and where electricity is supplied under a provisional order, and the mains pass over roads and streets, the consent of the local authority must be first had and obtained. If, however, the cables are erected by a company supplying electricity on their own account without a provisional order, mains which are high enough not to interfere with the traffic can apparently be stretched across roads and highways outside the County of London, without the consent of the highway or other local authority.

CORRESPONDENCE.

Technical Terminology.

When any doubt arises about the meaning of a word or symbol, the inventor's meaning should be referred to, and if the terminology has not appreciably changed in the interval, the inventor's meaning should be retained. Honour to whom honour is due! In the paper read by Mr. W. M. Mordey before the Institution of Electrical Engineers on May 23rd, 1889, the following passage occurs:—

PERIODICITY.

Some confusion is caused by the various ways in which rates of alternation are expressed, it being often quite uncertain whether periods or half-periods are referred to when "alternations" or "reversals" are spoken of. This confusion should be avoided by using the term "period," which has, I think, always been taken as expressing the complete cycle, or the changes undergone by a simple rectangle or elementary armature rotated from zero through a complete revolution in a simple magnetic field. To save confusion, I always write it thus ~; and I would suggest that this sign be used unless a better one be forthcoming, and that we agree to speak of periods, instead of alternations or reversals, and of periodicity instead of frequency or rates of alternation or reversal.

Since that date compositors have been accustomed to whittle down 8s if they have not got a ready made ~ in their fount. Mr. Mordey did not expressly state that ~ means "periods per second," but it is quite clear from the context that he so uses it.

There is something to be said for "frequency" as being a less pedantic word than "periodicity," but the pair of words "period" and "periodicity" go excellently together, and avoid the confusion of the expressions "frequency" and "cycles." I doubt whether "frequency" is longer established than "periodicity."

I do not think that the writer of the article is right in putting "juice" as a synonym for "P.D.," or pressure, &c.; it is generally used for current, and is a delightfully modern adaptation of "electric fluid."

X. Y. Z.

[Seeing that Mr. Mordey's intention was the same as our own—namely, to secure uniformity—we are pleased that he should receive due credit, where an improvement has resulted, but we would willingly have spared him the association of his name with that unfortunate and obsolescent symbol. We cannot quite agree with our correspondent that the context shows the original meaning to have been "periods per second"; it appears to us that the sign ~ was intended to graphically represent a "complete cycle," including a positive wave and a negative wave. In the paper referred to, however, Mr. Mordey uses the symbol indifferently for "periods" and for "periods per second"! Again, we fail to find confusion in the expressions "frequency" and "cycles." As for "juice," we must confess to but a limited acquaintance with American slang, and it is well known that a *little* knowledge is dangerous. But suppose, for example, an American electrician were connecting up an electrostatic voltmeter or testing a cable; would he not call upon his assistant to switch on the "juice," or "—— juice," although no current could or would flow? We are reminded, in this connection, of the British term "fluence," which has a very static flavour, and is used in a similar way.

Our grievances were not exhausted in our article last week; we had not expressed our preference for "polyphase" in place of the hybrid "multiphase"; for "stationary transformer" in place of "static transformer"; for "direct" *vice* "continuous" current; and so on.—EDS. ELEC. REV.]

Fault Finding.

I notice in your issue of the 7th inst. a letter by "Mains," criticising a letter by me in your issue of 24th ult. I shall be pleased if he will explain how to locate a fault within a few yards by testing a long length of cable with an ohm-meter. In the breakdown criticised an ohm-meter and generator were used when the cut-and-try method was started at service boxes to find the faulty length, but I have known mains, which have had an insulation resistance of over a megohm when tested this way, to break down under a pressure test of less than their working voltage.

Faults have occurred in consumers' premises often enough to make it worth our while to send men round to examine disconnecting gear, &c., and, as a rule, it saves time to disconnect consumers' transformers instead of disconnecting the outer from earth at the works, or the split fittings on outer in boxes, with the possibility of finding the fault between inner and outer only, and not to earth. The telephone method would probably be the best to locate a dead short to earth, but there are difficulties in testing this way with a faulty main which only breaks down under pressure. It would be very interesting to have the methods adopted in various towns for locating faults published in your paper, but I think the "cut-and-try" method (at joint boxes, if possible, replacing the short faulty piece when found) is very generally used.

Station Engineer.

The Economy of Isolated Electric Plants.

In view of your article on the above subject in your current issue, it may interest you to have the working results of a London installation, of which I have had charge for some years.

The plant consists of three Babcock & Wilcox boilers, supplying steam to three Willans direct coupled sets, and one horizontal engine, driving dynamo by belt. Total, 450 I.H.P. The plant supplies current for lighting only.

No accumulator battery is employed. Three engines being run on load, and the fourth kept as stand-by.

The plant runs on an average 10 hours per day during 9 months of the year, and 14 hours per day during the three winter months.

The following is a copy of my analysis of costs for the last three years :—

	1898.	1899.
Capacity of plant installed	75 KW.	140 KW.
Maximum load observed	50 KW.	90 KW.
Total electricity generated	84,564 units	131,8[illegible]6 units.

Cost.	1898. £	s.	d.	Per unit. d.	1899. £	s.	d.	Per unit. d.
Coal and other fuel	346	16	0	·98	526	15	0	·95
Oil, waste, water and stores	85	3	5	·24	178	18	3	·32
General repairs and renewals	50	15	0	·14	135	10	7	·24
Wages chargeable to generating costs	244	0	0	·69	308	15	0	·56
Works cost	726	14	5	2·05	1,149	18	10	2·07
Depreciation	210	5	0	·59	293	11	0	·53
Rental value of engine and boiler house	75	0	0	·21	100	0	0	·18
Total costs	£1,011	19	5	2·85	£1,543	9	10	2·78

ANALYSIS OF COSTS, 1900.

Capacity of plant installed	215 KW.
Maximum load observed	137 KW.
Total electricity generated	154,002 units.

Cost.	1900. £	s.	d.	P unit. d.
Coal and other fuel	745	3	0	1·15
Oil, waste, water and stores	199	2	3½	·41
General repairs and renewals	77	7	7	·10
Wages chargeable to generating costs	376	14	6	·58
Works cost	1,405	13	4½	2·24
Depreciation	344	1	6	·53
Rental value of engine and boiler house	115	0	0	·11
Total costs	£1,864	14	10½	2 88

The saving in comparison with taking the same current from the supply mains for the above years, was as follows :— 1898 = £740 2s. 3d., 1899 = £1,202 19s. 9d., 1900 = £1,343 12s. 7½d.

The Supply Company's charge was 5d. per unit. It will be noticed that these figures agree in a remarkable manner with those of the American plant quoted in your article.

W. Newton Dumaresq,
Chief Engineer, Derry & Toms, Kensington, W.

Improved Testing Tank.

In the letter which appeared in the ELECTRICAL REVIEW for February 7th, 1902, it is stated that it was not contended that with Mr. Lindley's device the normal conditions could be obtained at the time of starting up the generator. If this is so, then I claim an advantage over his tank, because, as stated in my last letter, in my case the temperature of the electrolyte is practically the same at the finish as at the start under any load, since it only requires more water passing through the tank when running a larger dynamo ; therefore it is not necessary to wait for the temperature constant, and by having a scale marked on the screw showing the distance required apart of the electrodes, for any given load, I do not see any reason why this could not be set at the commencing of the run.

Your writer must know that when starting up a new engine and dynamo on trial, there is a possibility of a stoppage, and should he have to shut down for a time, say half an hour or more, during this time of stoppage the temperature will be rapidly falling, so that by the time he is ready to start up again he will find the load has considerably altered, therefore he must run then on a part load for some time, waiting for the temperature to come up to the last temperature readings, or again go through the trouble of bringing the electrodes together, and after a short space of time, commence to open them apart, until the required load is once more set, which is a waste of time compared with my arrangement, in which the temperature of the electrolyte is always down to its normal state, either during a run or stoppage.

With regard to the amount of water passing through the tank, those figures given are only in the case of running a very large dynamo, and as a vast quantity of energy has to be dissipated, it is absurd to attempt to show that he could deal with this amount of energy, and keep the temperature down, without an equivalent amount of water. But why should this be considered waste, since it was shown that the water was drawn from some source, say the condenser well, and after passing through the tank it ran back into the well again, therefore incurring practically no waste.

As to the half-hour longer run, I imagined that the 143° F. rise was a gradual one from the commencement to the finish of the run, hence my conclusion ; but your writer states this was not so. The great increase of temperature was during the first 20 minutes' run, even with the cooling apparatus at work. Then I can only say that it shows what a very feeble effect it has on the rising temperature, and it also shows that the temperature constant is fixed, not by the cooling device, but the amount of radiation which takes place after the temperature rise.

Dealing with the latter part of his letter, in which he says that I am discreetly silent upon the sloppy state outside the tank, I can only say that such a state of affairs should not be allowed to exist. If the tank is watertight, which it should be, then with an overflow twice as large in the bore as the feed pipe, also 3 in. below the top of the tank, and providing the overflow is clear, there need not be any fear of the tank overflowing, and as nothing is put into the tank or taken out beyond the water flowing through, why on earth should there be anything approaching a sloppy state ?

One thing cannot be denied, and that is, the nearer you can keep the temperature of the electrolyte down to its normal state, the better the results all round must be, and this can only be done by having a good supply of water, which should (I should say) pass into the tank forming the electrolyte.

By so doing, as every one knows, the cold water would go to the bottom where the heat is generated, and force the warm out through the overflow, then this must have a far greater effect in keeping the temperature down with a less quantity of water than any device which operates at one end, and the heat is generated at the other, besides a waste of two-thirds of the tank.

In the tank that I have mentioned we have run two small dynamos with different voltages, both running at the same time, and either can be stopped or started without affecting the other. I have tested a large number of dynamos, alternators and continuous current machines, both on the wire resistances and on water resistance, and can safely say that water is much better than wire resistances for getting a steady load.

Yrreb, *Electrician,*
Birmingham.

PARLIAMENTARY.

OPPOSITION TO PRIVATE BILLS.

A VERY large number of petitions have been lodged in the Private Bill Offices of the Houses of Lords and Commons praying to be allowed to be heard in opposition to various Bills before the Select Committees which will be appointed to consider the measures. The Newport and Swansea Corporation are opposing the South Wales Electrical Power Distribution Bill; the Brighton Corporation, the Brighton and Rottingdean Seashore Railway ; and the Middlesex County Council and a number of Urban District Councils, the Bill of the North Metropolitan Electric Supply Company. There were six opponents to the North Metropolitan Tramways Bill, including the County Councils of London and Middlesex and the National Telephone Company. Five petitions from Urban District Councils are deposited against the Middlesex County Council tramways. The measure of the Newcastle-on-Tyne Electric Supply Company is opposed, amongst others, by the promoters of the Northumberland Electric Power, the Newcastle and District Electric Lighting Company, and the Northern Counties Electricity Supply Company.

The L.C.C. is opposing the London & Tilbury Railway Bill, with three other opponents. The Salford Corporation seek to be heard against the Manchester and Liverpool Electric Express Bill; and the London and North-Western Railway, the Eccles Corporation, and the Stretford Urban District Council petition against the Manchester Corporation tramways. Eleven opponents have already appeared against the Metropolitan District Railway Bill, including the London Electric Supply Corporation, the Kensington and Knightsbridge Electric Lighting Company, the promoters of the North-East London Railway, and the L.C.C. There are already nine opponents of the Metropolitan Railway Bill, amongst them being the Middlesex and London County Councils and the Baker Street and Waterloo Railway. All the London County Council measures will be fought. The Crystal Palace Electric Supply Company is in the field against the Council's General Powers Bill; the Central London Railway and the Paddington Corporation is opposing the Tramways and Subways Bill; and the Stepney Corporation and the Metropolitan Electric Supply Company, the Council's Electric Supply Bill. The Great Eastern Railway will oppose the Norwich Corporation (Electric Tramway) Bill, and the Southport Corporation, with others, seek to appear against the Southport and Lytham Tramways. Amongst the opponents to the Cavehill and Whitewell Tramways, is the National Telephone Company; the Great Western Railway is against the Cornwall Electric Power Bill; the London and North-Western Railway against the Erdington Tramways; and the Great Northern oppose the Finchley Improvement Bill. Already there are eight petitions against the Gloucester Electric Power Bill, and nearly 30 against the Kent Electric Power Bill, in the latter case the opponents include the Chatham, Rochester, and District Electric Lighting Company, the Isle of Thanet Electric Tramways, and a large number of corporations and other local bodies. Eight petitions are lodged against the Leicester and Warwickshire Electric Power Bill, including one for the Warwickshire County Council. Nearly 40 petitions are lodged against the Brompton and Piccadilly Circus Railway, most of them being from property owners. The North and South Shields Electric Railway is opposed by the Tyne Improvement Commissioners, and others. The Edgware and Hampstead Railway is opposed by the Hampstead Borough Council and the Midland Railway; the Great Northern and City Railway, by the North London Railway; the Great Northern and Strand, by the Borough Councils of Westminster and Holborn; and the King's Road Railway, by the Metropolitan District Railway, and the Westminster Borough Council. There are about 50 petitions against the London United Railways, including the County Councils of London and Surrey, the Westminster Electric Supply Company, Baker Street and Waterloo Railway, the promoters of the Charing Cross and Hampstead Railway, the Metropolitan District Railway, and the Brompton and Piccadilly Circus Railway. The Piccadilly and City Railway has against it the Metropolitan District Railway, and the Brompton and Piccadilly Circus Railway; while the Gordon Hotels Company is opposing the Baker Street and Waterloo Railway Bill. The South Wales Electric Supply Company is opposing the Abertillery District Council Bill. The Bradford Corporation in their Bill have as opponents the Leeds and Pudsey Corporations, some Urban District Councils, and the Great Eastern Railway. The City and Crystal Palace Railway will be vigorously opposed by the City Corporation, the competing railways, the City and Brixton Railway, the Midland Railway, and the promoters of the North-East London Railway Bill. Twenty-four petitions are lodged against the City and North-East Suburban Railway, including those of the Metropolitan Railway, the Great Eastern Railway, the L.C.C., and a number of local bodies. There are 16 petitions against the Central London Railway, the opponents being the Kensington and Knightsbridge Electric Light Company, the Notting Hill Electric Light Company, the Metropolitan Railway, the Metropolitan District Railway, the Brompton and Piccadilly Railway, and a number of others. The Charing Cross, Hampstead and District Electric Railway has eight opponents, including the Baker Street and Waterloo Railway Company. The North-East London Railway (No. 2) Bill is being opposed by the promoters of the City and North-East Suburban Electric Railway, the Metropolitan District Railway, and the Brompton and Piccadilly Railway. The Lancashire and Yorkshire Railway is opposing the Manchester District Telephone Board. The Central London Railway has a number of opponents, including the Hammersmith Borough Council, and the same Council is opposing the Charing Cross, Hammersmith and District Electric Railway. A very large number of petitions are lodged against the City and North-East Suburban Electric Railway (No. 2).

The Standing Orders Committee has decided to allow Standing Orders to be suspended in the case of the West Ham Corporation Bill and allow the Bill to proceed. Powers are taken to extend the electric lighting and tramways undertakings.

On 13th inst. Mr. Jeune, the examiner, found that Standing Orders had been complied with in the case of the Newcastle-on-Tyne Electricity Supply Bill, which gives the Newcastle-on-Tyne Company various fresh powers.

On 13th inst. the Donegal Railway Bill and the North Staffordshire Tramways Bill were found to have complied with the Standing Orders of the House of Lords.

The following Bills came before Mr. Jeune on 14th inst. for proof of compliance with Standing Orders:—

Cavehill and Whitewell Tramways.—To empower the Cavehill and Whitewell Tramways Company to work their tramways by electricity, and raise £60,000 additional capital.—Standing Orders were found to have been complied with.

Northumberland Electric Tramways.—The necessary proofs of compliance with Standing Orders were given in the case of this Bill, which empowers the Northern Counties Electric Supply Company, Limited, to construct tramways from Morpeth to Bedlington, Bebside to Blyth, and Ashington to Newbiggin.

Tyneside Tramways and Tramroads Company (New Lines and Extensions).—A Bill to empower this company to construct a number of new tramways, and to raise £60,000 additional capital.—Standing Orders were found not to have been complied with, and the Standing Orders Committee will accordingly have to decide whether the Bill shall be allowed to proceed.

The following Bills came before Mr. Campion on Monday for proofs of compliance with Standing Orders of the House of Commons:—

City and Brixton Railway.—The Standing Orders were found to have been complied with in the case of this railway which authorises the company to abandon portions of their authorised undertaking, and to enter into agreement with the City and South London Railway.

Derbyshire and Nottinghamshire Electric Power Bill.—The necessary proofs of compliance were forthcoming in this case. The Bill has already been described in the Electrical Review, the object being to repeal certain portions of the company's Act of 1901, prohibiting the erection of generating stations on land other than that described in the schedule.

Hove, Worthing and District Tramways.—In this Bill it is sought to construct certain new tramways in lieu of the existing tramways, and to work the same by electrical energy. Power is also sought to construct a number of new tramways. It was found that Standing Orders had not been complied with, and the Bill will accordingly have to go before the Standing Orders Committee, who will decide whether it will proceed.

Electric Lighting (London) Bill.—On Monday the above important Bill came before the Examiner. The object of the Bill, which is a Government measure, is to provide for the adjustment in accordance with changes of boundary effected under the London Government Act, 1899, of the area within which the local authorities and companies are authorised to supply electricity. Clause 1 provides that where by reason of any alteration of boundary under the London Government Act any area, being part of the area of supply, of a metropolitan borough council has become situate outside the borough, that area (except as otherwise provided) shall be from January 1st, 1903, transferred to and become the area of supply of the borough council in which it has become situated if the council is authorised to supply electricity within the borough, or if not that of the company authorised, but only if the area of supply of the council or company adjoins the transferred area. Clause 2 enacts that where by reason of any alteration of boundary a part of the area of an authorised company, or an area in regard to which no order exists becomes situated in a borough for which the local authority is the authorised undertaker, then such areas shall become part of the area of the council. The section shall not, however, apply in the case of an area being part of the area of supply of a company where (*a*) the area consists of a whole parish or the greater part of a parish; (*b*) where the company is authorised to supply within the borough in which the area has become situate or any point adjoining the area. The provisions of Clauses 1 and 2 as to transfer shall not in the case of any part of an area of supply in which mains or other works suitable to and used for the supply of electricity have been laid down or executed before the 1st day of January, 1902. The Board of Trade may, if they think it expedient, confirm (*a*) any agreement for the transfer of any part of an area of supply of one company to an area of supply of another company, made with a view of making the boundaries of metropolitan boroughs; and (*b*) any agreement for the transfer of an area which would have been so transferred under this Act if mains or other works suitable to, and used for, the supply of electricity had not been laid down or executed therein before January 1st, 1902. Clause 6 gives the Board of Trade power to postpone the transfer of any area if application is made before April 1st, 1903, to the effect the council or the company to whom the transfer should be made under the Act is unable to give a proper supply of electricity within the area. The same clause also provides that, when the effect of any transfer is to separate any works of an authorised council or company from their area of supply, or when it is proved to the satisfaction of the Board of Trade that it is convenient that any mains used for the purpose of supply in an area of supply of a council or company should continue to be laid in a transferred area, the Board of Trade may order the council or company to have the same powers as before the transfer with regard to the breaking up of streets, &c. All questions arising out of the Act with reference to transfers will be settled by the Board of Trade. Standing Orders were found to have been complied with.

London and Brighton Electric Railway Bill.

On Monday Mr. Campion, the Examiner, commenced the consideration of the London and Brighton Electric Railway Bill, to ascertain whether Standing Orders had been complied with. There were several memorials alleging non-compliance, the principal objectors being the London, Brighton and South Coast Railway. The chief allegations of the company were that the promoters had omitted certain buildings from the plans, and that other plans were incorrect and mi-leading. It was further alleged that the Brighton and South Coast Railway had power to take water from the river Mole, and that the promoters had not "referenced" in respect of their rights in regard to that river. Another allegation was that the statements by the promoters as to a number of houses occupied by

the working classes which would be taken in the course of the construction of the new line, were incorrect in several particulars. The promoters of the Bill were represented by Mr. Tetley, Parliamentary agent, and Mr. Cripps, K.C., appeared for the London, Brighton and South Coast Railway.

The inquiry was adjourned.

On Tuesday the consideration of the Bill was resumed, and the examination was again adjourned.

LEGAL.

Charles Bright & Co.

Before Mr. Justice Byrne, on Thursday last week. In this case the River Plate Construction Company and Bright's Light and Power petitioned for the compulsory winding up of the company.—Mr. Greenwood appeared for the company, and asked that the petitions might stand over for a fortnight. The only person who knew the circumstances was Charles Bright, who was now being examined before the magistrate at Guildhall. He was instructed to say that Mr. Bright had been approached with regard to making an affidavit, but they had been unable to get one from him because he was in Holloway, and only his solicitor could see him.—Mr. Justice Byrne asked for the names of the directors of the company.—Mr. Greenwood said they were Mr. Moreno, Mr. Rowland Hastings, Senor Rehdor, and two other gentlemen, but he was instructed that they had all been comparatively recently elected.—Mr. Justice Byrne said the petition had been standing over for some time now, and at the end of a fortnight counsel for the company might come with the same story.—Mr. Greenwood said no harm could possibly be done, because there was a provisional liquidator.—Mr. McSwinney, in support of the petition of the River Plate Construction Company, said that his clients were creditors of the company, which was incorporated in November, 1898, with a capital of £200,000, divided into 20,000 shares of £10 each. He submitted that no defence to the petition had been shown.—Mr. Justice Byrne pointed out to Mr. Greenwood that he had failed to give evidence to support his bare statement that there was a good defence. Mr. Greenwood replied the defence seemed to be a judgment debt. No doubt it would be the plea either of accord and satisfaction or a set off. Might the matter stand over in order that he could get an affidavit filed ?—Mr. Justice Byrne said he could not adjourn the case. It was a perfectly clear case.—Mr. Greenwood replied he was told that the defence would be that the petitioner owed a larger sum to the company than was due to him. A discussion then followed as to on which petition the order should be made. Mr. Eve, K.C., said it was most important that the winding-up order should refer back to the earliest date; Mr. Bright had transferred 6,000 of his shares to a young lady typewriter in his office, and he (the learned counsel) wanted to ask him something about that.—Mr. Justice Byrne thought it would be best to make the usual compulsory order on both petitions, as they appeared to have been advertised together. Order accordingly.

Chas. Bright's Trustee *v.* Moreno and Another.

This case came before Mr. Justice Buckley in the Chancery Division on Saturday and Monday last, an action brought by the trustee in Mr. Chas. Bright's bankruptcy for a declaration that 1,003 fully-paid shares held by the defendant, Mr. Joaquin Fermin Moreno, were the property of the bankrupt, and belonged therefore to the trustee. His Lordship gave judgment for the plaintiff with costs.

In *re* the Madeira Electric Lighting Company, Limited. Halifax Joint Stock Bank *v.* the Company.

In the Chancery Division of the High Court on Tuesday this action came before Mr. Justice Byrne on a motion for judgment, and Mr. Percy Wheeler said he moved for judgment in default of appearance in the above action, which was one by debenture holders. The matter was before his Lordship last month, when a receiver and manager was appointed. The plaintiffs were the holders of 211 out of the 300 debentures, and interest was in arrear. He, therefore, asked for judgment in the common form. Mr. Justice Byrne made the order asked for.

Meek, Jones & Co. *v.* Snepper.

This case was tried on Monday in the Brompton County Court by his Honour Judge Stonor. Plaintiffs were electricians, &c., of Blackfriars Road, and defendant a hairdresser, of Brompton Road. When defendant took the shop he engaged plaintiffs to fit it up with electric light and do other work in connection with the basins, &c. In addition to work included in an estimate there was a charge of £3 12s. 9d. for extra plumbing work. The action was brought in the High Court for £24 odd, and was remitted under Order 14 on defendant paying £8 10s. into Court with a denial of liability. There was a counterclaim for £21.

Arthur Jones, having given evidence, denied in cross-examination that the £3 12s. 9d. was for work included in the estimate, although the price included "all necessary plumbing." He employed a proper plumber. He did not know that the plumber put his foot through a ceiling.

Samuel Pharo, in plaintiffs' employ, said defendant called at plaintiffs. Witness saw him. There were to be 10 lights, but it was altered to eight 16-candle and one 32-candle light, for £10. He said he had an offer for the plumbing, and suggested plaintiffs should do it for £4. That was agreed. Then there were enamel letters put on the saloon window, the extra plumbing work, &c. As to a hole in a water pipe, defendant caused that by knocking a nail in it to hang his coat on.

Several witnesses were called for the plaintiffs.

Defendant said the charge was to be £9 for nine lights. The £3 12s. 9d. work was included in the £4 for plumbing. The whole came to £14 10s., and plaintiffs gave him credit for a payment of £6. That left £8 10s., the amount paid into Court. The counterclaim was for £2 for the hole caused by the plumber putting his foot through the ceiling; £2 10s. for the holes bored and not stopped in another ceiling—bored to find rafters for electric fittings; £4 damage to the wall-paper, caused in connection with a hot-water arrangement in the shaving saloon; £1 15s. for each of two marble slabs damaged, and damages for loss of business through plaintiffs taking so long to do the work that he had to shut at 5 p.m., as there was no electric light.

His Honour said the claim for damages must go.

That part of the counterclaim was abandoned.

His Honour found plaintiffs were entitled to £8 10s., and gave them judgment for that amount. On the counterclaim he found for the defendant for £5 10s., with costs.

Wilkinson *v.* The Mayor and Corporation of Newcastle-on-Tyne.

In the Chancery Division on Monday and Tuesday this case came on for hearing before Mr. Justice Joyce.

Mr. Younger, K.C., and Mr. R. J. Parker appeared for the plaintiffs, and Mr. Hughes, K.C., and Mr. T. Watson for the Corporation.

Mr. Younger, in opening the case, said the action was brought by the plaintiffs, a firm of solicitors in Newcastle-on-Tyne, for an injunction to restrain the defendants from permitting a certain double line of tramways which they had laid down in alleged contravention of statutory powers comprised in an Act of Parliament passed in 1889. The plaintiffs were the owners in fee simple of valuable property situate at the corner of Pilgrim Street and Moseley Street, Newcastle, the site of which they purchased in 1898 for £20,000. On this site the plaintiffs built offices, the ground floor being occupied by the Norwich Union Fire Office, and the rest of the building by other tenants. It was incumbent, said the learned counsel, that express notice should be served on the frontagers in regard to this tramway, which must be not less than 9 ft. 6 in. from the pavement. The defendants denied having contravened the Act, and traversed the other allegations in the statement of claim, and said that the construction of the tram lines was completed before the action was commenced. The learned counsel said that if the work of the Corporation was to be justified under Sec. 7 of the Act, it must be on the ground that it was a junction. He submitted it was not a junction. The word "junction" used in the Act of Parliament showed that it meant in every case a point of contact between two lines. There was one junction expressly pointed out on the deposited plan, and this was a junction in Pilgrim Street, to the south of the plaintiffs' premises. The Court could not construe the words "works or conveniences" in Sec. 7 of the Act so as to extend to a fresh line of tramways. If these tramways remained opposite the plaintiffs' premises, the free access to them would be practically cut off so far as carriages were concerned. The injury thus caused would be accentuated if the original design of the plaintiffs in regard to their property was carried out and the premises now occupied by the Norwich Union Fire Office and others were converted into shops. Since the action had been commenced the plaintiffs had been served with another frontager's notice by the Corporation, who were now promoting a Bill in Parliament to authorise the construction of the tramways they had already made. He asked his Lordship to grant the plaintiffs the relief they sought.

Mr. Hughes, for the defence, submitted that the Corporation, in applying to Parliament, were simply striving to put their rights beyond dispute, and that the works complained of were necessary and proper junctions.

In the result his Lordship, after hearing evidence, gave judgment, ordering the Corporation to remove so much of the rails not shown on the deposited plans as was within 9 ft. 6 in. of the footway; but he suspended the operation of the injunction over August 31st, and gave defendants liberty to apply for an extension of the time.

In the meantime the defendants undertook not to use the piece of the tramway in question. The defendants were also ordered to pay the costs of the action.

Laing, Wharton & Down, Limited, *v.* Spiers & Pond, Limited.

The case of Laing, Wharton & Down, Limited, *v.* Spiers & Pond, Limited, came before the Court of Appeal, composed of the Master of the Rolls and Lord Justice Mathew on Saturday, the 15th inst., on appeal of the plaintiffs from an order of Mr. Justice Jelf, in chambers, dated January 23rd, 1902, affirming the order of the Master on a summons for directions whereby he ordered that the action should be stayed and referred, under the terms of the contract, to the engineer of the defendants.

Mr. Spencer Bower appeared as counsel for the appellants, and Mr. Montague Lush for the respondents.

It appeared, from the statement of Mr. Spencer Bower, that the action was brought by the plaintiffs, a firm of electrical engineers, to recover from the defendants £1,576 3s. 1d, the balance they alleged to be due to them under two contracts, one in respect of work done in the electric lighting of the Hotel Metropole at Blackpool and the other in respect of work done at the Granville Hotel, Ramsgate.

Lord Justice Mathew said he understood that the action was stayed by the Master and the judge because of the arbitration clause in the contracts.

Mr. Spencer Bower said that was so, and what he wanted to get out of, if he could, was a reference to the engineer of the other party. He should ask their Lordships to say that, as there were points in dispute under the contract not referred to the defendants' engineer, the whole of the matters must be tried. If there were some matters referred to the arbitrator under the contract, and some not, there was authority for saying that the Court would not order two fights, but would direct that the whole of the matters in dispute should be tried together in the ordinary way. He should ask the Court to say that the action should proceed, and then, if necessary, be referred to an official referee. The learned counsel went on to state that the plaintiff company went into liquidation before the work in question was completed, and the defendants alleged that the work was not properly done, and called in other contractors to complete it. Apart from the question of defective work, there were numerous questions with regard to the work and the prices charged for it. The defendants had paid, during the course of the work, £800 on account in regard to each of the contracts to the plaintiffs. The learned counsel said that one of the main questions in dispute was as to extras or additional work, which he contended was not under the arbitration clause referred to the engineer of the defendants. The only things referred to that gentleman were disputes relating to the quality of the workmanship and materials.

The Master of the Rolls: Your point is that he is not appointed arbitrator to decide whether extras were or were not extras?

Mr. Spencer Bower: Yes, that is the whole point. I am most anxious that the case should go before an official referee. I not only consent to that course, but ask for it.

Mr. Lush submitted that on the proper construction of the contracts, the question of extras was referred to the arbitrator, viz., the defendants' engineer.

The Master of the Rolls, in giving judgment, said he thought it was clear from the terms of the contract that the parties intended that all disputes arising under the contracts should be referred to the defendants' engineer, and that the plaintiffs must submit to his jurisdiction.

Lord Justice Mathew concurred, and the appeal was dismissed with costs.

Buchanan & Curwen *v.* Hughes.

In the Westminster (London) County Court, on Wednesday, his Honour, Judge Woodfall, had before him the case of Buchanan and Curwen *v.* Hughes, which was a claim for 20 guineas for plans supplied.

Charles Curwen said he was a member of the plaintiff firm of electrical engineers carrying on business at 68, Victoria Street, S.W. On April 2nd last he had an interview with the defendant, Mr. Hughes, of "Whitehall," Crawley, Sussex, in connection with the latter's intention to have an installation of electric lighting at his house. They went over "Whitehall" together, and witness was directed to prepare plans of the electric lighting plant, and also to draw up a schedule of the lamps. The plans were made and handed over to the defendant. Subsequently, witness was told that another firm's estimate had been accepted. Witness asked for the return of the plans, and after a time received them. He then found unmistakable signs that they had been copied. In the centre of various of the circles were pin-holes, which had not been there when the plans were delivered over. Having found that the plans had been made use of, witness applied to defendant for the money for the plans and the other work done. Twenty guineas was a fair and reasonable price to charge.

His Honour: Would you have prepared plans like this if you had been instructed only to give a tender for the wiring of the house?

Witness: No, sir; these plans have nothing to do with the wiring. I should have prepared a schedule of lamps in any case.

Cross-examined, Witness said his firm would have made no charge for the plans if their estimate had been accepted.

Alexander Shaw, who drew up the plans, described the method by which those delivered to defendant were prepared. The drawing was traced, and photographed by an arc lamp. Thus, on the completed plan, which was coloured by hand, there could not be any pin-holes at all, except to make a copy.

Defendant stated that he showed the plans to Mr. Radford, a member of another firm competing with the plaintiffs, and allowed him to take the plans away with him, but did not in any way authorise him to copy them.

His Honour: You used plaintiffs' plans to cut their prices down.

Cross-examined, Witness could not say why he did not reply to plaintiffs' letter, in which they said he had copied the plans.

His Honour: It imputes a mean trick to you.

After further cross-examination, his Honour said: Defendant has admitted that he made use of the plans by giving them to Radford.

Mr. Radford said he ultimately obtained the work for his firm. They were not consulting engineers, but electrical. He had the plan (on linen) made, but he should certainly say that it was not a copy of plaintiffs' plan. His draughtsman had plaintiffs' plan before him.

Finally, his Honour gave judgment in favour of the plaintiffs for £14 14s.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Feb. 19th, 1901.	
Alexandria	Value £154
„ Teleg. wire	145
Amsterdam	204
Bangkok	43
Boca. Teleg. mat.	543
Bombay	135
Brisbane	100
„ Teleph. mat. ..	150
Buenos Ayres. Teleg. mat. ..	300
„ Teleph mat. ..	250
Calcutta	2,124
„ Teleg. wire	176
Cape Town	1,410
Christchurch	17
Christiania. Teleg. wire ..	133
Colombo	120
Copenhagen. Teleg. wire ..	18
Durban	1,391
Fremantle. Teleph. mat. ..	444
Flushing	18
Genoa	72
Gibraltar	23
Hamburg. Teleg. mat.	676
Hong Kong	112
Launceston	100
Malta	16
Melbourne	802
„ Teleg. cable ..	1,087
Nagasaki	80
Otago	204
Piræus. Teleg. mat.	40
Port Elizabeth	175
Rotterdam. Teleg. wire ..	46
Sandakan	20
Sascho. Teleg. cable	1,412
Shanghai	342
Singapore	90
Stockholm	24
Sydney	1,220
Syra. Teleg. mat.	94
Wellington	94
Total ..	£14,603

Week ending Feb. 18th, 1902.	
Adelaide	Value £402
„ Teleg. cable	249
Amsterdam	83
Auckland	80
Bangkok	26
Bombay	400
Buenos Ayres. Teleg. mat. ..	289
Calcutta	400
„ Teleg. cable	100
Cape Town	413
„ Elec. cable ..	760
„ Elec. tramway mat.	955
Carlskrona. Teleg. wire ..	467
Cocos. Teleg. apparatus ..	241
East London	274
Fremantle	410
Ghent	10
Gothenburg. Teleg. wire, 132 cwt.	—
Grenada. Telephones	14
Hamburg	27
Jamaica. Elec. cables	4,219
Melbourne. Teleg. wire ..	1,750
Monte Video	40
Nagasaki	20
Otago	30
Para. Teleg. cable	53,000
Perth	140
Port Said	25
Reval	204
St. Petersburg	10
„ Teleg. wire ..	100
Shanghai	687
Sydney	437
Total ..	£66,162

Foreign Goods Transhipped.

Paris. Elec. mat. ..	Value £250	Fremantle. Elec. mat.	Value £188
Perth. Elec. tram mat. ..	80		
Total	£330		

Bankruptcy Proceedings.—The first meeting and public examination in the case of Herbert Cooke, electrical engineer, Birmingham, are arranged for February 26th and March 13th respectively at Birmingham.

Dissolutions and Liquidations.—At a meeting held on 11th inst., in London, it was resolved that the Sussmann Electric Miners' Lamp Company be wound up voluntarily, with Mr. R. W. Fea as liquidator.

Messrs. C. B. King, jun., & E. R. Smith (C. B. King, jun., and Co., electrical engineers, Hampstead) have dissolved partnership. Mr. Smith will carry on the business under the old style.

Blackpool.—We understand that Messrs. Rowland Carr and Co., electrical iron founders, of Lime Street Square, E.C., have secured the contract for the supply and erection of an artistic covered way and arcade for the "Blackpool Gigantic Wheel," Blackpool. The entrance will be lighted and ornamented by hundreds of electric incandescent and a large number of arc lamps, and will no doubt be a very fine example showing how a handsome cast-iron structure can be made more beautiful by the aid of electricity.

Books Received.—"Le Mois Scientifique et Industriel," January 25th, No. 5. Paris: 23, Boulevard des Italiens. 2 fr.

"Annual Report of the Smithsonian Institution for the Year ending June 30th, 1900." Washington: Smithsonian Institution, 1901.

Catalogues and Lists.—The new electric heating and cooking catalogue of the General Electric Company (1900), Limited, has now been issued, and its special feature is the complete manner in which the various apparatus is listed and standardised. Of course, some of the articles described may be termed luxuries, but there are others, such as saucepans, frying pans, fish kettles, hot plates and many commonplace kitchen utensils. The G.E.C. electric radiators have already been described in these columns, but there are several forms for industrial applications, such as ship radiators, car heaters, electric irons for domestic and laundry purposes, glue pots, sealing-wax heaters and so forth. All of the apparatus detailed in the list are of British manufacture.

The Foster Engineering Company, of Newark, U.S.A., has forwarded to us an illustrated catalogue in which are detailed the Foster pressure regulator (reducing valve) and other specialities for steam, water, gas and air.

From Messrs. Reavell & Co., Limited, of Ipswich, we have received a copy of their new catalogue, in which are given notes on the design and build of their engine, the economical results and the general advantages attending its use. The Reavell engine has quite recently been described in the columns of this journal. Amongst the recent orders executed or in hand are engines for the following town lighting plants:—Heckmondwike, Horsham, Heywood, High Barnet, Dartford, Sutton Coldfield, Grays Thurrock, Aston Manor, Llandrindod Wells and Gravesend; also for the following Asylums:—Chadwell Heath, Suffolk County, Norfolk County, Brookwood, Burnley Union Workhouse, &c.

Pamphlet No. 118 of the B.T.H. Company gives particulars of their various standard field rheostats.

We have received from Messrs. O. Berend & Co. a copy of their No. 26 trade price list of Hartmann & Braun's portable moving-coil instruments, type W. Also from the same firm there has come to hand a trade list of the "Oberon" arc lamps and arc lamp accessories.

Messrs. Monté Callow & Co., of Ludgate Broadway, E.C., are sending out lists giving revised prices for ammeters, and describing the "Perfecta" motor starters and shunt-field regulators.

Dia's Patent Safety Gloves.—For some time past the St. Helens Cable Company, Limited, has been experimenting with a rubber glove which should combine the high insulating qualities of pure Para rubber with some material to take the actual wear and tear which would otherwise fall upon the rubber, and it is now putting on the market what is called Dia's patent safety glove. Every one of these gloves is tested with 5,000 volts before leaving the works, and has attached to it a brass label bearing the number of the test certificate, which is also sent out with the glove. For high pressure switchboard work such gloves are absolutely indispensable, and they might also, with advantage, find a place on all electric trams, to be used in cases of emergency. So far as we are aware, no other gloves on the market are tested with 5,000 volts, and in a great number of cases they are not electrically tested at all. A sample glove has been forwarded to us which we regard as greatly superior to any similar article previously brought to our notice. We are assured that it was tested with 8,000 volts alternating current for five minutes without breaking down.

Dinner.—The first annual dinner of the London Electrical Contractors' Association was held at the Hotel Cecil on the 13th inst., the president, Mr. W. R. Woodward, occupying the chair. There were nearly 200 guests, including Prof. Perry and Mr. Theodore Beran (President of the U.S. Supply Dealers' Association), and a considerable number of British manufacturers were present. After an excellent dinner, followed by the loyal toasts, Mr. G. Douglas Bate proposed "The Association." Pointing out that the orders received from contractors form a minority of the orders received by manufacturers, he suggested that the Association was "asking a lot" in restricting the grant of trade discount, and must be prepared to give a *quid pro quo*. In reply, the President said they were asking nothing but their rights, which they were determined to defend; it was a shame that less than half the orders came through contractors, and the sooner this was set right the better for all. Replying for "The Visitors," proposed by Mr. W. W. Strode, Prof. Perry said that the contractors' contention was founded on common sense. If the object was merely to increase their profits, he had no sympathy with them; but if they were trying to enable better work to be done, he was with them every step. Replying also to this toast, Mr. Theo. Beran paid a high tribute to the commercial probity of British tradesmen, which was looked upon by his compatriots as the highest among the nations. The President and Mr. Oppenheimer paid glowing compliments to the hon. secretary, Mr. E. J. Hogan, which were enthusiastically endorsed by the meeting, and the proceedings closed with the toast of "The President," proposed by Mr. Gillard. An excellent programme of songs was carried out during the evening.

Electrical Fittings Company.—This company, to which a reference was made in our Fittings Number on November 8th, has now opened its showroom at 38, Conduit Street, New Bond Street. This showroom, for electrical fittings only, is certainly one of the finest in London, is 110 ft. in length, and is specially wired and fitted up for the effective display of all kinds of electroliers, pendants, brackets, standards, &c. A great advantage is that the whole is in one range and on the ground floor. The company supplies through the trade only, and its undertaking is, therefore, calculated to be a great convenience to those who have felt the need of an establishment of this kind centrally situated in the West-end, to which they can send clients to study the effect of various styles and materials, and to choose the most suitable for their requirements. The manager is Mr. S. B. Marshall, formerly of the General Electric Company.

Electrical Supply Test Question.—Last week Mr. Alfred J. Plappert, of Upper North Street, Poplar, was summoned, at the instance of the Poplar Borough Council, for not paying his account due for electric supply. Mr. Young, who appeared in support of the summons, said up to June 28th a sum of 8s. 9d. was due from the defendant for electric supply. That went on until August 8th, when, at the defendant's request, the supply was discontinued. Mr. Plappert: During that time I only used seven units. Mr. Young: We were entitled to charge 13s. 4d. The collector, in the service of the Poplar Board, produced a request from the defendant requesting them to supply his house with electric energy. For that the charge was 8s. 4d. and 5s. for hire of fittings. When the supply was discontinued a proportionate claim of 3s. 4d. was made. In answer to the summons, the defendant said he had not signed any agreement, and therefore could not see that it was binding. His idea was that he should only pay for what was used, and 3s. 4d. represented the amount supplied. The magistrate ruled that the defendant must pay according to the scale. An order would be made for the payment of 12s. 6d. and 3s. 6d.

Escher Wyss Turbines.—In spite of the great depression of trade on the Continent at the moment, it is interesting to note that the firm of Messrs. Escher, Wyss & Co., of Zurich, Switzerland, who are represented in the British Empire by Mr. Alph. Steiger, of 28, Victoria Street, Westminster, S.W., during the year 1901 received orders for 170 turbines, developing altogether 48,000 B.H.P. Mr. Steiger has now in hand several orders for turbines for electrical work, one for the electric light installation of a town in the West of England, and one of 250 B.H.P. for a private firm in the North of England.

The General Electric Company (1900), Limited.—The twelfth annual dinner and smoking concert of this company were given on Saturday last in the Grand Hall of the Hotel Cecil, and a large and distinguished audience assembled. There were many ladies present to brighten by their presence the proceedings of the evening, which were lively and cheerful, notwithstanding the length of the speeches. The latter were very numerous, and witty beyond the usual run of post-prandial speaking, but owing to the length of some of them, the smoking concert had not commenced at 10 o'clock, the hour at which our representative was obliged to leave the festive scene. The directors and heads of departments were present in the persons of Messrs. Gustav and Max Byng, Messrs. H. Hirst, H. Bevis, A. Eckstein, T. Hawkins, M. Railing, and others. The visitors included many who are well known in the electrical profession.

Mr. Gustav Byng, who, we were pleased to see, looked very well, proposed, after dinner, the usual loyal toast, which, needless to say, was enthusiastically received. He then proposed "The Army, Navy, and Reserve Forces," coupling the toast with the name of Captain Lloyd. By an amusing slip, he alluded to conscription, and suggested the formation of what he would call compulsory volunteers. Captain Lloyd having responded, afterwards came the toast (also from the chairman) of "The Staff." He recounted the fact that the company now employed 5,000 hands, and was undoubtedly the largest electrical manufacturing concern in the country.

Mr. Brooker, having been called upon to respond, did so in a lengthy, witty, and most interesting speech, commencing by expressing the delight of the staff and himself at seeing the head of the firm in the chair once more. He alluded to the confidence of the staff in the other members of the board of directors, mentioning the name of Mr. Hirst as the company's great diplomatist, causing much amusement by stating that one of the juniors of the staff had been overheard to bet three teas at an A.B.C. shop that it would be found that Mr. Hirst had had a principal hand in the successful negotiation of the Anglo-Japanese alliance. He also gracefully alluded to the fact that Mr. Eckstein's reputation in Manchester was as great as that of any of the directors in the South. Mr. Hirst then proposed "The Friends," discoursing merrily on the various types of engineers, including the consulting engineers, who know everything, there being only their assistants who know everything better.

In proposing the toast of "The Ladies," it was said to be not an unmixed blessing to be the wife of an engineer, and that it was only right that the ladies should have an opportunity once a year to see that their husbands were out on business.

Prof. Perry, in replying for "The Visitors," referred to the good comradeship which existed in the company, and regretted that an impromptu speech from him required at least a week's notice.

Messrs. Berry, Robt. Hammond and Roger Wallace, K.C., having spoken, Mr. Mordey then, in feeling terms, proposed the good health of "The Chairman," to which Mr. G. Byng having briefly responded, an adjournment was made previous to the commencement of the smoking concert, an excellent programme for which had been arranged by Mr. A. E. Izard. During the dinner charming music was played by the "Red Band," and altogether the whole entertainment was especially varied, good and exceedingly well organised, a delightful evening being the result.

Imports of Foreign Electrical Plant.—According to returns just issued, the value of the foreign electrical goods and apparatus imported into this country during last month, reached a total of £63,304, as compared with £54,447 in December last, and £94,317 in January, 1901.

North Wales Law Suit.—In the King's Bench Division of the High Court of Justice last week Mr. Justice Walton delivered judgment in the case of Jones *v.* the Colwyn Bay Electric Power Company, which was heard before him at the last Mold Assizes. The action was brought by Mrs. Hannah J. Jones, proprietress of a plumbing business at Colwyn Bay, against the Sheriff of Flint and others, who were execution creditors of the Electric Power Company. The question was whether certain machines were tenant's fixtures, and liable to be sold under a sheriff's order, or were part of the freehold, and belonged to the plaintiff as owner. The Judge said he had come to the conclusion that the engine was a tenant's fixture, and could be removed without causing material damage to the premises, and that the sheriff was right in selling it. The sheriff only sold enough to satisfy a judgment for £100 and to pay his costs. There would therefore be judgment for the defendants, with costs, and he granted an injunction to prevent the plaintiff from removing or dealing with the gas engine, &c.

Plant for Sale.—Manchester Corporation want offers for four vertical compound engines and four 250-kw. shunt-wound dynamos. See our "Official Notices" this week.

Trade Announcements.—Messrs. Moores, Farrell and Co., of 26, Victoria Street, Manchester, have recently been appointed sole agents for the North of England for the Consolidated Telephone Construction and Manufacturing Company, Limited.

Mr. A. B. Child, A.M.I.E.E., has resigned his position as engineer and manager to the Galway Electric Company, Limited, to enter into partnership with Messrs. J. P. Child & Co., of Woolwich, electrical and mechanical engineers and contractors.

Mr. E. O. Sachs announces that, with a view of obtaining some relief on the executive side of his practice, arrangements have been made by which he will have the co-operation of Mr. G. Spencer Hoffman, M.A. Mr. Hoffman will practice with Mr. Sachs as his junior partner, and the business will be carried on in the names of Edwin O. Sachs & Hoffman.

ELECTRIC LIGHT AND POWER NOTES.

Bristol.—The City Council has adopted the Electrical Committee's report accepting the tender of Messrs. Kemp Bros. to wind and keep in order the clocks controlling electric meters for three years, at the rate of 7s. per clock per annum, and has resolved that a petition be addressed to the Home Secretary to secure the exemption of their electrical undertakings from requirements as to periodical lime washing under the Factory and Workshop Act of 1901.

Dorchester.—The T.C. has decided to employ an engineer of repute to advise the Council as to the best method and the cost of electric lighting.

Elland.—A L.G.B. inquiry was held last week into an application made by the U.D.C. for sanction to borrow £11,094 for the purposes of electric lighting.

Falkirk.—The T.C. has agreed to approve generally of the machinery recommended by Mr. Burstall, engineer, and to instruct him to prepare the general conditions, specifications, schedules, &c., for the electricity works.

France.—An agreement has been arrived at between the Commune of Estaing and M. Boyer, proprietor of the Moulin d'Olt, for the utilisation of this site for the construction of a central power station for the electric lighting of the commune.

A project for the lighting of the Place de la Republique, Place de la Comedie, and Place des Terreaux, Lyons, has been formulated by the Municipal Council; it comprises 70 arc lamps of 10 amperes on posts 5 metres high.

M. de Vilaine, engineer, Paris, has secured the concession of the electric lighting of Montebourg.

For some time past the Gouffre of Padirac has been lighted by electricity. The current is supplied by the central power station of Carennac, 8 kilometres distant. This station, installed on the banks of the Dordogne, from which it obtains its motive power, comprises two turbines of 60 H.P. each, of the Maison Bonnet, Toulouse, driving a Brown-Boveri three-phase generator of 120 H.P. The current, at a pressure of 4,000 volts, supplies, in addition to the Gouffre, the town of Gramat and the Communes of Lavergne, Théqra, Padirac, Carennac, Bétaille, Vayrac, as well as the St. Denis terminus near Martel. Thiers and Alvignac will also be connected with the central station at an early date. The system will thus be 35 kilometres long. This installation, executed by the Compagnie Electro-Mecanique, Paris, for M. Dunoyer, of Segnzozac, proves that the employment of currents at high pressure permits of the connection with a single generating station of a number of communes, and the realisation in this way of an economic installation of considerable extent.

Heckmondwike.—The U.D.C. has adopted a recommendation that application be made to the L.G.B. for sanction to borrow £6,500 for the extension of the electricity works, so as to supply the British Electric Traction Company with energy for the tramways which they are about to construct in the district.

Lancaster.—Ald. W. Bell, an ex-mayor, not satisfied at receiving a summary of the minutes before the Council meeting, telephoned for Mr. Tester, the electrical engineer. He was told to call at the works, but when he did call he found that Mr. Tester was out on business, and his assistant declined to part with the specifications of the machinery required, without his superior's orders. The Alderman waxed warm, and is alleged to have threatened the officials. The chairman of the Electricity Committee protested against Mr. Alderman Bell's action in threatening the officials, who were perfectly right in refusing to hand over documents to a member of the Council who was not on the Electricity Committee. The minutes were adopted by a very large majority. It was mentioned that by placing the contract for the steam dynamos with the British Westinghouse Electric Manufacturing Company, one-third of the contract would probably be done by American labour, but the Committee could not help themselves. They had paid a higher price than they would have for equipment from Continental firms.

Leeds.—It is proposed to light several streets in the centre of Leeds—East Parade, Infirmary Street, Park Row, Cookridge Street, and Woodhouse Lane as far as the end of Blackman Lane—by means of electricity from the electric lighting works, special standards being erected to carry the arc lamps.

Leicestershire.—Subject to the interests of the Council with regard to its main roads being duly protected, the County Council has decided not to oppose the Leicestershire and Warwickshire Electric Power Bill now before Parliament.

London.—Strand.—A fire broke out on Monday morning in the electric wire manhole opposite the Adelphi Theatre. Dense volumes of smoke poured out, and a number of fire engines were quickly on the spot. The fire, which was due to the explosion of a workman's blow-lamp, was soon extinguished with sand.

Perth.—The Corporation electricity works was opened on June 1st, 1901, with nine consumers connected. The total number of consumers now connected is 150; total lamps connected 15,688 8-c.p., and units generated during January, 47,494, showing a very rapid growth in the demand, such as must be highly gratifying to the Corporation and to Mr. J. Lambert, the burgh electrical engineer.

Plymouth.—The demand is rapidly increasing, and the Electricity Committee intends to expend £12,000 on additional machinery, mains, &c., during the current year.

Port Glasgow.—The T.C. last week appointed a committee to consider the propriety of introducing electric light into the burgh.

Portugal.—Plant is about to be put down to utilise the water power of the River Pateiro, in the Guarda districts, in the generation of electrical energy for lighting and power purposes.

Sheffield.—The Corporation has received the sanction of the L.G.B. to a loan of £348,376 for the purpose of the electric lighting undertaking.

Spain.—A company has been formed at Alcala de Henares to establish a central electric lighting station in the town. The plant to be put down will comprise two 60-H.P. Crossley gas engines, each connected up to a dynamo.

Plant is about to be put down to utilise the water power of the River Ara, at Toria (province of Huesca), in the generation of electrical energy for lighting and power purposes.

South Durham.—Some 12 months ago the South Durham Coal Company decided to adopt electrical power in connection with the pumping arrangements of the Eldon Colliery, and the installation, which is now nearing completion, will, it is stated, be the largest electrical pumping plant in the North of England. The plant consists of a compound horizontal engine of 450 H.P., with a generator of 250 kw. capacity at a pressure of 500 volts. The generating plant is situated 800 yards distant from where the pumping is required, the current being carried overhead by conductors on poles and taken down the shaft by heavily-armoured cables to two sets of three-throw pumps, each set of pumps delivering 500 gallons per minute, or, collectively, 1,000 gallons against a head of 400 ft.

Sunderland.—In our note under this heading last week we unintentionally misquoted Mr. Snell. It seems that the Corporation electricity department sold 96,000 units in its first year, and that the probable output for the current year is estimated at 2½ million units. These figures serve to show the rapid growth of the undertaking and the need for extensions to cope with the demand.

Surbiton.—The U.D.C., after nearly three years' negotiation, has authorised its clerk to seal an agreement with Messrs. Callender, Limited, for the lighting of the district subject to the approval of plans and the consent of the B. of T. The scheme is for the Council to raise a loan of £50,000, and for the company to carry out the work, pay the interest and instalments, and make over the works to the Council after due notice, not earlier than within seven years, on the Council paying a small premium. The charges for energy are to be 7d. and 3d. per unit, on the Brighton system. The company will deposit security to 10 per cent. of the Council's outlay.

Sussex.—The County Council has appointed Mr. Albion T. Snell, engineer, to act in conjunction with the architect in preparing specifications and supervising the work of carrying out an electric lighting installation at the Asylum.

Swinton.—A special meeting of the General Purposes Committee of the Swinton and Pendlebury District Council has been convened to consider a report prepared by Mr. C. H. Wordingham on the question of the Council undertaking an electric lighting scheme for the district or receiving electricity in bulk from an outside company.

Switzerland.—A new central power station has been constructed at Sublin principally with a view to supplying current to the Bex-Villars-Gryon electric railway, of which the last section has just been finished, and upon which trials are now being made. The energy is obtained from the Avancon, a torrent which falls from the Alps, and of which the supply of water is, thanks to numerous tributaries, relatively constant. For a long time past the waters of this river have been utilised in the lower reaches for industrial purposes, principally by the Salines of Bevieux, who

installed a factory of 600 H.P. In 1896 an electric station was constructed on the upper reaches near La Peufaire, for the lighting of the communes of Gryon, Villars, and Chesières. Between these stations there was a difference of level of about 170 metres, which is being utilised by the new power station of Sublin. There are six turbines of 400 H.P., running at a speed of 600 revolutions per minute. They are of the Escher-Wyss type with horizontal axis, and provided with the electric regulator of the same constructors. The electric material comprises four three-phase Wellington alternators and two Thury dynamos, supplying the neighbouring sections of the electric railway. The four alternators produce at a speed of 600 revolutions per minute, three-phase current of 33 amperes at a pressure of 5,000 volts and a frequency of 50 cycles per second. The two continuous current generators can supply normally 300 amperes at 650 volts. The lighting service is obtained from one of the phases of the three-phase current. The sub-stations are equipped with transformers for the lighting. The copper supply wires are aerial, supported on ordinary insulators. The Bex lighting system supplies about 2,650 lamps. The cost of electric energy for lighting depends upon the duration of the lighting, the price varying from 1 f. to 1·70 f. per candle-year. For motive power the energy is sold at 45 f. per annum for 200 watts, 80 f. for 400 watts, and 150 f. for 800 watts. Eleven hours' supply is allowed daily.

Willesden.—A recommendation of the Electricity Committee to the effect that the Council should advertise with a view to obtaining tenders from companies or persons willing to undertake the management of the electricity works and the supply of current for a period of years upon the understanding that the Council was indemnified against the sinking fund charges on its capital outlay, has been defeated in the Council.

Yarmouth.—The quarterly report of the electric light receipts show a profit of £659 after meeting all expenses, and paying £850 to interest and capital account. There are now 585 customers with 27,804 lamps.

ELECTRIC TRACTION NOTES.

Ashby, Swadlincote, and Burton.—At the Swadlincote Town Hall, on 6th inst., an inquiry, which lasted eight hours, was held by Colonel Boughey, R.E., C.S.I., and Mr. Henry Allan Stewart, as to the expediency of granting the application for an order for the proposed Ashby, Swadlincote, and Burton Light Railway. Mr. G. W. Wells, assistant manager of the Midland Railway, called, expressed the opinion that the tramways would have a serious effect on the Midland line, and with a possible reduction of £2,000 of the total revenue of £6,000, it would mean trains being run at a loss.—Mr. Baggalay, addressing the Court, maintained that substantial competition with the railway company would be created, and the magnitude was such that it came within the section of the Act of 1896, and consequently the scheme was one which it was not intended should be carried by the Order, but should be reserved for Parliament itself to deal with.—Mr. Hutchinson, for the promoters, said that thousands of workmen were not carried by the railway company, and that it had not been shown that a single penny would be extracted from the company's coffers.—Colonel Boughey said the Commissioners felt that it would be quite useless for them to send an Order to the Board of Trade, because it had been shown that there would be a very sensible competition with the existing railway. They, therefore, rejected it on those grounds, but with regret, because out of the large number of inquiries they had held the public need for a line of the kind had never been more clearly proved than it had that day.

Belfast.—At the half-yearly meeting of the Belfast and County Down Railway Company last week the chairman, Mr. Andrews, said that he thought that at no distant time electricity would be found a suitable motor power for trains, but for the present the directors would carefully watch and wait. Their locomotive expenses came to 8d. per mile roughly, and even if electricity could do that at half price there would be a very small saving in a 12-mile run to Bangor. They were not anxious to be pioneers in the matter.

Berlin.—The electric overhead and underground railway was formally opened on Saturday by a trial trip of the Imperial, State, and municipal authorities. Among those who took part in it were Herr von Thielen, Minister of Public Works; Baron von Hammerstein, Minister of the Interior; General von Gossler, Minister of War; Herr Kraetke, Secretary of State for the Postal Department; the directors of the railway company, and representatives of Messrs. Siemens & Halske.

Blackburn.—At the Town Council on 6th inst. Councillor Hamer invited an authoritative statement from the Electricity and Tramways Committee respecting the loss of £4,400 on the tramways undertaking during the past nine months. The ratepayers, he considered, were entitled to some explanation. Was it a fact, he asked, that some 30 cars were standing idle? If so, what was the reason, and why had the Committee given orders for others so long before they were required? They had to be paid for, and the interest for the purchase money, paid out of revenue, handicapped the Committee in their efforts to make the trams pay. Ratepayers who did not use the tramways ought not to be called upon to pay for the convenience of the others who did, and either the trams ought to be self-supporting or not under the ratepayers at all. Answering these and other questions put by several members, Alderman Crossley, vice-chairman of the Committee, said he was not going to say that the Committee had not made mistakes. The initial mistake was in estimating the use that would be made of the trams when once they were set going in the town. Every member of the Committee and the Council believed they would be largely used, and that opinion naturally gave rise to the work of preparation which the Committee took in hand to meet the traffic. That estimate had been falsified, experience showing that the Committee had not made that full use of the cars which had been anticipated. Another mistake in the initial stage was, to his mind, the lowering of the fares. That mistake gave rise to another. It was believed that the reduction of fares to 1d. all round would bring a large increase of passengers, and to meet that increase a large number of additional cars were ordered, for, owing to the long time occupied in executing such orders for cars, it was necessary that the Committee should look well ahead. The Committee had also to consider the probability, as it then appeared, of the tramway system being carried through all the various routes in the town, as specified by the Act of Parliament, and for which a certain number of cars would, of course, be required. The consulting engineers, he explained, did not receive a commission upon all the cars, but only upon the first three or four, nor did the consulting engineers advise them that that large number of cars would be required The Committee, in conjunction with their own engineer, decided that. He believed that it would be possible to effect economies in working and to increase the revenue also. It was the easiest thing in the world, continued Alderman Crossley, referring to various points mentioned, to utter complaints and pick holes in the management, but it was quite another thing to devise and apply a remedy. It was unfair, for example, to compare Blackburn with Manchester, Liverpool, or any of those large towns and cities which ran successful tramways. There were not many towns such as Blackburn, with its steep and continuous gradients and its sudden turns, which all presented difficulties to the working. Nor could they find in Blackburn, as in Manchester or Liverpool, that continuously moving population constantly jumping in and out of the tramcars. The Blackburn trams were not used throughout the day, and in the very heart of the town in mid-afternoons they seldom found more than two or three persons riding on the cars, which were mainly used by people going to and from business and their meals. The great bulk of the work, therefore, was not equally distributed throughout the day, and consequently exceptional loads had to be provided for. Here came in the difference between a municipal and a private tramway system. He had no hesitation in saying that if he or the Committee had charge of the tramways on their own account they could make them pay, because they would put profit-making in the forefront and the public convenience and comfort in the background, whereas the Committee had reversed that order of things, and given the public the best, the quickest, and most convenient service, besides improving the lot of the employés. Then the unfortunate accident at Elwood had cost the Committee over £2,000 in compensation, and the period covered by the statement included the quarter when the receipts were lightest and the working expenses heaviest. The Committee, he assured the Council, in conclusion, was doing its duty as well as it could in the circumstances, and was battling against many difficulties, of which outsiders had not the slightest conception, to the best of their ability.

Brighton.—The Elm Grove and the Queen's Park routes were opened for traffic for the first time on Thursday, the 6th. These were the only remaining ones, so the whole system is being worked at present with 26 cars, but more will be added as quickly as they can be finished. The number of passengers carried averages about 120,000 per week, and the Committee has considered this a sufficient number to warrant ordering other 10 cars similar to the present ones, to be delivered in time for the summer traffic.

Carlisle.—At the annual meeting of the Electric Tramways Company held at Carlisle last week, it was stated that the number of miles covered by the cars last year was 323,044. The total expenditure per car-mile was 4·63d., but the result of the year's working had been a disappointment. The people of Carlisle had not supported the tramways to the extent that had been expected. The traffic receipts had been 6·23d. per mile, whereas they had calculated on receiving 10½d., this difference of 4d. per mile being equal, on the total mileage, to about £5,000.

Central London Railway.—The C.L.R. Company, in order to minimise the probability of fatal accidents on the line, have removed the planking between the centre rail and the line next the platforms. A person falling on the line will now, in the case of the near approach of the train, be able to place himself out of danger by dropping into the recess beneath the line. By this means it is also probable that attempts at suicide will be frustrated, for in the event of a man deliberately throwing himself in front of a train, the chances are in favour of his dropping between the rails into the cavity, instead of his remaining upon the metals. These measures were adopted in preference to a proposal to place a light railing at the edge of the platform.

Failsworth.—The D.C. is taking steps to obtain the sanction of the B. of T. to the borrowing of such moneys as may be required for the purchase of the tramways from the Manchester Carriage and Tramways Company and their reconstruction for electric traction. The D.C. has also decided to inquire of the Electric Power Company, Manchester, with respect to the terms on which the company would supply the district with energy.

Hendon.—Messrs. Burns & Cripps, engineers to the Hampstead, Hendon, and Edgware Railway, recently attended a meeting of the Ratepayers' Association to explain the scheme. It was stated that it would start from Heath Street, Hampstead, at a junction with the Charing Cross, Euston, and Hampstead line, and would run under Hampstead Heath and through Hendon to Edgware, near the Great Northern Railway Station. There would be stations at Hampstead, Finchley Road, Brent Bridge, Hendon (near the Burroughs), Colin Deep Lane, and Edgware. The line would be worked electrically, and would run over ground except under Hampstead Heath, and near the Purroughs, Hendon. The shortest distance from the surface of the Heath would be about 86 ft., and the greatest 200 ft. As the tunnels under the Heath would be driven in London clay, it was difficult to see in what way they would affect the surface of the Heath. The generating station would be in Colin Deep Lane, Hendon. Powers were sought to enable the company to take over the Charing Cross, Euston, and Hampstead Railway if that railway had not been commenced within six months of the passing of the Act, and the powers would be vested jointly with the L.C.C. Interchange stations would be provided with the Metropolitan Railway in the neighbourhood of Euston, and with the Central London in Oxford Street. It would probably take 35 minutes to travel from Hendon to the Bank, and it was proposed to have a 6 to 9-minute service. It was stated that the Bill had passed Standing Orders, and it was the intention of the promoters to further the Bill in every possible way. A resolution was moved pledging the meeting to support the scheme.

Lancaster.—On Friday the T.C. authorised contracts and other work connected with a new generating station, and the construction of certain lines of tramways, amounting in all to £28,000. (See "Contracts Closed.")

Leigh.—The T.C. last week decided to apply for powers to construct tramways in the town, which are estimated to cost £60,000.

Liverpool.—The extensive tramways system of Liverpool stood the dense fogs, heavy snow, and hard frost of last week admirably. The service was maintained with fair regularity through the week. One accident, which was attributed to the slippery state of the rails owing to the frost, took place in Eastbourne Street on Friday last. This street crosses the bottom of Fitzclarence Street, one of the steepest gradients on the Liverpool system; at the bottom there is a very sharp curve. Shortly before eight o'clock on Friday morning, a car going towards the city was descending Fitzclarence Street. When near the bottom of the street, the driver was unable to control the car, which accordingly left the rails at the bottom of the street and continued its way over street and pavement, striking the lower part of a house with sufficient force to break through the outer brick wall and wreck the room within. Fortunately the passengers in the car were uninjured. Traffic on the street was suspended until the car had been drawn back from the house and placed again on the rails, a difficult and tedious operation. The inmates of the house escaped without injury.

At the adjourned monthly meeting of the City Council on Wednesday of last week, a long discussion took place following a motion by Mr. John Japp, that a proposal of the Tramways Committee for a certain appropriation of revenue from the tramways be referred back for further consideration. In the course of the discussion, Mr. Utley urged that an expert's report should be obtained as to the depreciation of the tramway plant. In his opinion, the tramway track would cost £3,000 per mile for renewal within the next 10 years, and the Committee would have to spend something like £300,000 on renewing this part of the plant. Alderman F. Smith, deputy chairman of the Tramways Committee, said that, as to the tramway rails, how could their length of life be foretold? For instance, at the junction of Paradise Street and Church Street 4,000 cars passed during a day, whereas, at other points, a car passed probably only once in a quarter of an hour. The life of rails could only be measured by experience.

Manchester and Liverpool.—Last week a special meeting of proprietors in the Manchester and Liverpool Electric Express Railway Company was held at the company's offices in Cornhill. The company is seeking to obtain a further Act of Parliament authorising it to deviate the line as it passes through Salford, in order to meet the wishes of the Salford Corporation, and the meeting was called to pass a formal resolution approving the new Bill. Mr. Behr, the inventor of the mono-rail, reported that the Board of Trade had approved the plans in general. There were still some minor details to be settled, but certain modifications which the Board of Trade had suggested had been carried out and the plans re-submitted.

Middlesex.—As a result of mutual discussion by correspondence, the Middlesex County Council Tramways Bill is being separately petitioned against by the local authorities of Brentford, Chiswick, Ealing, Edmonton, Hampton, Hampton Wick, Hanwell, Heston-Isleworth, Southall-Norwood, Sunbury, Teddington, and Twickenham.

Middleton.—The Electricity Committee have had an interview with the Manchester Corporation with regard to the Middleton and Blackley Tramways. Manchester told the Middleton representatives that the reason they had not gone on with the work, was that they could not supply the necessary current for some indefinite period. The deputation gave the Manchester Corporation to understand that they were prepared to supply the current when the Manchester Corporation were prepared to construct the tramway. The Middleton T.C. have fixed terms on which they will supply energy to Manchester for the running of the trams. It has been suggested to the B.E.T. Company that an experimental car may be run on their lines on March 8th and the 22nd of the same month for the supplying of the whole service. Mr. Pauls (electrical engineer) was empowered to engage the working staff at the electricity station.

Neath.—Application has been made to the T.C. to transfer the lease held from the Corporation by the British Electric Traction Company, Limited, to a new company in course of formation to be called the Neath Traction Company, Limited.

North Metropolitan Tramways.—At the half-yearly general meeting held last week of the North Metropolitan Tramways Company, the chairman referred to the notification received from the L.C.C. of its intention to convert the lines to electric traction. He thought the overhead system could be carried out more easily, and at a much lower cost than the conduit system, and he failed to see that its adoption would interfere with the beauty of anything in the North of London. Moreover, in many places the pipes were only 2 ft. below the surface, and the crown of the sewers still less. The Council had to find the capital, and the company to pay the interest on it. A Bill was submitted to the meeting authorising the conversion to the trolley system of the company's own lines, with which the L.C.C. has nothing to do. These lines will join the new Middlesex light railways, and are of great value.

Oldham.—For over three weeks work has again been stopped through wretched weather. Messrs. Hewitt & Rhodes (electrical engineers) have suggested that the Tramways Committee should rent an old mill and erect temporary plant so as to enable them to run as many cars as possible on the new routes, which will be ready in a short time after the weather again becomes favourable for commencing operations. Mr. Hewitt considers this course would obviate the necessity of waiting for the completion of the new electricity station and be more profitable to the Committee and more convenient to the public as the extra energy would allow a better service of cars to be run. The Committee are considering the matter with the view of carrying out the suggestion.

Pontypridd.—The D.C. possesses powers to run tram lines to Treforest and Calfraydd, and it is said that the Council is likely shortly to apply for a prov. order to run trams through the town to the junction of the British Electric Traction Company's tramways between the town and park.

Rochester.—There is a proposal on foot between the Chatham Town Council and the Rochester (the sister town) Corporation, with a view of joining in a joint tramway scheme, to connect the outlying part of Chatham with the cathedral city. The Chatham Electric Tram Company are just about to open their service of trams in the town of Chatham and New Brompton and Gillingham. Rochester refused to join in the permission for the Chatham Electric Tram Company to extend their rails to the ancient city, having some idea of introducing a scheme of their own. Now it is thought that the two towns should join hands, and make a line from Luton (the east end of Chatham) over the New Road into Rochester High Street. The matter was thoroughly discussed at the Chatham T.C. meeting, and the matter was referred to the Highways and Works Committee.

Southport.—The reduction of the fares to High Park from 2d. to 1½d. has resulted in the loss of about £5 during the month of January. The Committee have decided to double the service of trams on this route on Saturday evenings, commencing Saturday, 15th.

West London.—On Thursday in last week a deputation from the Chiswick and Acton District Councils, together with representatives of some religious bodies, were received at the B. of T. offices by Sir Herbert Jekyll, the deputation protesting against the speed and the number of the L.U.T. cars running in the districts. On the same occasion the L.U.T. Co. presented a petition signed by 50,000 of their passengers approving the company's services. Sir Herbert Jekyll said that the Board could not interfere unless a special Act were passed. The clerk to the Chiswick U.D.C. having subsequently offered some suggestions, Mr. J. Clifton Robinson promised the deputation to do all in his power to minimise the inconvenience complained of. The speed of cars had already been reduced, and in future gongs should not be sounded on Sundays near places of worship.

The Heston-Isleworth U.D.C. has decided to memorialise the B. of T. against the speed and number of the D.U.T. electric cars passing through the district.

Wigan.—The annual meeting of the Wigan and District Tramways Company, Limited, was held at Wigan on Tuesday. A dividend for the half-year of 10 per cent. was declared. A special meeting of the shareholders will be held to consider the offer recently made by the Corporation to purchase the tramways undertaking from the company.

Windsor.—Colonel G. F. O. Boughey, R.E., C.S.I., and Mr. H. A. Steward, Commissioners, with whom was Viscount Emlyn (acting secretary) held a public inquiry at the Windsor Guildhall on Thursday last week, as to the expediency of granting an application which has been made to the Light Railway Commission by the Metropolitan District Electric Traction Company for authority to construct a light railway between the towns of Windsor and Maidenhead. Mr. Littler, K.C., and Mr. Fitzgerald appeared for the promoters; Mr. E. H. Lloyd opposed the application on behalf of the Great Western Railway; and Mr. Lewis Coward, K.C

objected to the scheme for the London United Tramways, Limited. The Maidenhead Corporation opposed upon the ground that they intended to construct a tramway of their own. The town clerk of Windsor said that his Council supported the construction of the tramway. Ultimately the chairman decided that the inquiry should be continued at Windsor, and that notice should be given of the day selected for its resumption.

Wolverhampton.—Mr. Henry N. Lea, electrical engineering expert, of Birmingham, has been chosen to inspect and report upon the Lorain system of electric traction in use on the experimental tramline on the Bilston Road. This action has been taken by the Tramways Committee in accordance with a resolution passed by the Town Council at its meeting on Monday.

TELEGRAPH AND TELEPHONE NOTES.

All-British Cable Scheme.—The large twin-screw cable steamer *Colonia*, built to the order of the Telegraph Construction and Maintenance Company for the purpose of laying submarine telegraph cables, has just been launched from the shipyard of Messrs. Wigham-Richardson & Co., on the Tyne. The vessel, which will carry about 3,000 nautical miles of cable in four large tanks built in her holds, is the largest cable ship afloat, being about 500 ft. in length, 56 ft. in breadth, and 39 ft. in depth. When completed she will carry 10,000 tons dead weight at a speed of 11½ knots. She has an overhanging bow and elliptical stern, both of which will be fitted with the necessary cable gear, and four-pole masts with fore-and-aft rig. The propelling machinery consists of two sets of triple-expansion engines working at a pressure of 190 lbs. per sq. in. As the vessel will have to work in all climates, particular attention is being paid to the ventilation, which is very thorough. The heating is by steam, and the lighting by electricity. When completed the *Colonia* will proceed to the Pacific to lay the cable from Vancouver to Fanning Island in mid-Pacific, whence it is to be continued to New Zealand. The project in hand is to complete the circle round the world of British-owned cables laid between points all of which are on British territory. A complete installation of cables such as this is possessed by no other nation.

American Cable Matters.—We gather the following interesting items from the *India-Rubber World*:—

At Washington, on December 4th, Senator Hale reintroduced the Pacific Cable Bill as it passed at the last Session of Congress. It provides for the construction by the Government of a cable from the western coast of the United States to Hawaii. In the House of Representatives three Bills have been introduced: (1) by Mr. Jones, of Washington State, proposing a Pacific cable, by the northern route, *via* Puget Sound, with an appropriation of $8,000,000; (2) by Mr. Corliss, of Michigan, proposing a Government-built cable; and (3) by Mr. Sherman, of New York State, offering a plan allowing private participation in the enterprise. During the past month there have been hearings before the Committees in the two Houses, to whom the cable Bills have been referred. The Commercial Pacific Cable Company's representatives appeared to protest against any legislation on the subject, and against Governmental competition with their enterprise. Western Union Telegraph interests, on the other hand, protest against a cable monopoly in private hands, maintaining a service which they could not use in sending trans-oceanic messages without being discriminated against. Hence they favour Governmental control of the new cable.

The New York *Electrical Review* says:—"There are not at present any cable-ships flying the American flag of capacity sufficient to undertake the laying of even the shortest length of the contemplated cable across the Pacific. It is chiefly to this lack that we must lay the blame for the contract for a trans-Pacific cable going to foreign concerns." The *Review* suggests that the Government equip as cable ships one or two of the foreign built vessels purchased for transport service during the war with Spain, and now no longer needed by the military establishment.

The contract awarded to a New York firm for the construction of nearly 500 miles of submarine cable for the Mexican Government was referred to in the last *India-Rubber World* (page 116). The cable is to be insulated with Pará rubber, put on by the seamless process. It is stated that the contract was secured in competition with European manufacturers, but that the high grade and good results from this form of insulation, as manufactured in the United States, won the contest, at a price in advance of the foreign tenders. "The warm waters of the Mexican gulf," it is stated, "and the resultant animal life, especially the *teredo*, make it advisable to use india-rubber insulation, as it has the double advantage of withstanding the heat and not being attacked by the *teredo* as gutta-percha is." During two years past over 1,000 miles of rubber insulated cable, built by this company, have been laid by the United States Army Signal Corps in the Philippine Archipelago, one section at a depth of 1½ miles. These cables, besides being subjected to the usual conditions of service, are said in some cases to have been required to meet emergencies never before equalled, owing to mishaps due to laying them in uncharted waters, the wrecking a cable ship, with the resultant strain on the cable and its long exposure to the sun, and so on. But all the cable laid is now working satisfactorily.

On January 6th bids were opened at Washington for approximately 250 miles of submarine cable for the Philippine service, to be made in every respect similar to that previously made by the Safety Insulated Wire and Cable Company (New York). On account of the success of the rubber-insulated cables already in use, the Chief Signal Officer of the Army awarded the contract to the Safety Company.

Cable Communications.—The Committee on this subject appointed in 1900 has submitted an interim report, stating that it is clear that the terms of the existing Joint-Purse agreement, under which the Russian and German Governments have the right to veto any reduction in the rates to India, require revision, and the agreement should be terminated without delay. The Committee also recommends modification of the International Convention, it being urgently necessary that a country in direct communication with one of its own colonies or dependencies should be free to fix the tariff without reference to other countries.

Cork. — The Secretary to the Treasury, replying to questions, said recently: No trunk telephone lines in Ireland, except one between Dublin, Belfast, and Drogheda, were transferred by the National Telephone Company to the Post Office, nor is anything known of a proposal by the company to connect Cork with Youghal, Mallow, Killarney, and Tralee. The trunk line between Dublin and Cork was constructed by the Post Office. The National Telephone Company have connected Cork and Midleton, as the company have certain exchange subscribers in Midleton, and both places are in the same local exchange area. The Postmaster-General would, however, provide any lines required if a guarantee were given, either locally or by the National Telephone Company, on the same terms as for extensions of the trunk wire system in other parts of the United Kingdom.

Eastbourne.—The T.C. has held a special meeting to discuss a recommendation to adopt municipal telephones. The Telephone Committee reported against acquiring the National Company's system in the Eastbourne exchange area, the cost being prohibitive. It was recommended, therefore, that the Corporation should undertake a system of its own, and a lengthy report and estimate, prepared by Mr. A. R. Bennett, of Glasgow, was laid before the Council. In this it was stated that Eastbourne would be an exceptionally cheap place to telephone, on account of the streets being invariably macadamised and easy to break up, and because, there being no other place of importance in the telephone area, no expenditure for junction lines would have to be incurred. Most of the existing subscribers were within a half-mile radius of the Town Hall, and the greater part of the remainder within three-quarters of a mile. Less than a dozen were outside the one-mile radius. The number of existing lines belonging to the National Company did not exceed 400, equal to about one in 108 of the population, but there was no lack of margin for development. In the present estimate the number of lines to be constructed and finished was limited to 600, with provision in the way of extra ducts and capacity of poles, &c., for another 600, so that the original number could be doubled without re-opening the streets. The proposal was to lay about 5½ miles of underground pipes, the distribution being chiefly by means of overhead spurs of bronze wire weighing 40 lbs. to the mile. It was estimated that £18 per line would be sufficient for a first-class metallic circuit telephone exchange system. The provision of pipes for extending from 600 to 1,200 lines would cost £2,400. The 600 completed subscribers' lines, including 20 public telephone lines and 12 junction lines to the Post Office for trunk and telegram service, worked out at £10,800, making a total of £13,200. The average receipts per line would be £5 7s. 6d. per annum at first, but later this could be reduced to £5 or even £4. He estimated the total revenue at £3,269 10s., and the annual cost at £2,988 19s. 8d., giving a net revenue of £280 10s. 4d. The estimate of the cost of extensions to distant parts of the telephone area was £1,390, and the period of the license he recommended should terminate in 1913. The Council debated the report and recommendations, but the matter was postponed for nine months.

Hastings Telephones.—Mr. Bennett's report on municipal telephones is in the hands of the Telephone Committee. Nothing is to be done at present, however, as the National Telephone Company has not yet stated what its terms of purchase will be.

Holywell.—The U.D.C. has read a letter from the Postmaster-General in response to a memorial from the Council with respect to the unsatisfactory telephone arrangements under which Holywell was made a special district. The Postmaster-General said that under the circumstances it would be useless to disturb the present arrangements. The Council resolved that an effort should be made to obtain a reconsideration of the memorial.

Southport.—The T.C. has entered into negotiations with the various neighbouring Councils, and they are proceeding satisfactorily, with the exception of Birkdale. The Committee's request to Birkdale was that the latter would grant it the same facilities which they were granting to the National Telephone Company. In return, whereas the National Telephone Company charged £9 per annum, the Committee would be prepared, after an initial charge, to do the same thing for £6. One object of the Telephone Committee was to obtain facilities to lay its cables while the Birkdale roads were "up" for the electric light and National Telephone Company's cables, so that they would not have to be disturbed a second time.

Sunderland.—The report of the Highways Committee, which was discussed two meetings ago and adjourned, recommending that the T.C. take the necessary steps for obtaining a license for a municipal telephone system in the Sunderland telephone area was further considered, and approved by a large majority.

Telegraph Rates to India.—In the House of Commons on the 17th inst., in reply to a question by Sir Edward Sassoon, Lord George Hamilton stated that the understanding with the Eastern and Indo-European Telegraph Companies is that if at any time after the introduction of the 2s. 6d. rate the average revenue of the companies' Indian joint purse of the three preceding years, whether wholly at 2s. 6d., or partly at 4s. and partly at 2s. 6d. a word, shall amount to £360,000, a rate of 2s. a word will be at once introduced, provided that the necessary arrangements can be made with the Foreign Administrations interested.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899 ..	..
Para-Maranham	March 1, 1900 ..	..
Alexandria-Laruaca	Jan. 19, 1902 ..	..
Assab-Massowah	Feb. 18, 1902 ..	..
Landlines :—		
"*Via* Hanekin" on Persian territory	Feb. 24, 1900 ..	..
Communication with Baranquilla and Cartagena	Dec. 8, 1900 ..	..

The Telephone Service.—In the House of Commons on the 17th inst. Sir E. Spencer asked if the Secretary to the Treasury could give a definite date when the Government service would be in working order and subscribers able to avail themselves of the new system, and whether the exchanges would be opened simultaneously both in the City and other parts of London.—Mr. Austen Chamberlain, in reply, said that the junction lines between the Post Office Central Exchange and the trunk wire system have already been completed, and those connecting the same exchange with most of the chief exchanges of the National Telephone Company, will, it is hoped, be ready for use in the course of the present week. It will then be possible to give an exchange service to those subscribers whose lines have already been completed, and to others as their lines are completed from day to day.

In reply to questions asked by Mr. Lough in the House of Commons on Tuesday, Mr. Austen Chamberlain stated the present position of the Post Office telephone service in the London area as follows:—The number of agreements for connections with the Post Office London telephone exchange system up to Saturday last was about 2,250, but many of these agreements cover the use of a number of exchange telephones. The work of connecting the premises of these subscribers with the central exchange by means of the underground system, which has already been constructed, is now in active progress; and an exchange service will probably be given to those subscribers to the central exchange whose lines have been completed in the course of the present week. Additional subscribers are being connected every day. The exchanges at Putney, Chiswick, and Kingston are so far advanced that the work of connecting subscribers can be taken in hand at once. The Westminster, Kensington, Wimbledon, Richmond, and Twickenham exchanges will begin working shortly. The exchange at Croydon and an exchange to serve Mayfair, Marylebone, and Bayswater will probably be completed by the end of the year. Arrangements are also in progress for an exchange at Hampstead, and the surveys for the underground work in connection with a number of other exchanges are nearly completed. The chief exchanges of the National Telephone Company, as well as of other licensees of the Postmaster-General, are connected by means of junction lines with the nearest Post Office trunk-wire exchanges. Where those exchanges are at post offices which are not always open the junction lines are extended to the nearest trunk-wire exchange at which a constant service is given, but the control of the lines and of the traffic is not in the hands of the National Telephone Company.

Tunbridge Wells.—The Corporation six months ago borrowed £10,000 to start a local scheme, but unexpected difficulties arose. Wires, which were to be overhead, had to be put underground, and costly detours had to be made. The financial result was that about £9,000 had to be spent in excess of the original estimate. An application has been made by the Corporation to the L.G.B. for powers to raise a further loan of £15,000 to clear off the excess on the original estimate and to make extensions. The subscribers at present number 513, and the charges are £5 17s. 6d. for an unlimited number of calls; £3 10s., with ½d. for every call; or £2 10s. to start with, and 1d. per call. There are 283 new applicants for connection, who, owing to the limited capital in the hands of the Corporation, cannot have their demands complied with. An inquiry was held for the L.G.B., by Colonel W. L. Coke, last week. The hall was crowded. It was estimated that after the yearly expenses, including £1,550 interest and redemption of loan, had been paid, there would, if the contemplated extension were made, be a profit of £1,086, although £525 had to be paid as a yearly royalty. Mr. A. R. Bennett, engineer to the Corporation, gave evidence, and the inquiry was adjourned till March 6th.

Wireless Telegraphy.—The Dominion Government announces that an arrangement has been made with Signor Marconi for the reduction of the present cable rates of 25 cents to 10 cents a word by wireless telegraphy, in return for a contribution towards erecting stations.

Mr. George Wyndham, M.P., has promised the Dover Chamber of Commerce that he will approach the Board of Trade with the object of getting that body to put down an installation of wireless telegraphy between the Goodwin lightships and the shore.

The Admiralty are completing arrangements for establishing a wireless telegraph between Portsmouth and Dover, and Portsmouth and Sheerness.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—March 6th. Twelve double-deck single-truck cars and equipments for the Corporation. See "Official Notices" February 14th.

Aberdeen.—March 6th. Overhead equipment, bonding, and cables for the Corporation tramways. See "Official Notices" February 14th.

Belgium.—March 1st. The municipal authorities of Ghent are inviting tenders until the March 1st, 1902, for the concession for an electric lighting installation. See our "Official Notices" January 3rd.

Belgium.—March 1st. Tenders are being invited until March 1st by the municipal authorities of Braine l'Alleud for the concession for the electric lighting of the town. Tenders are to be sent to Le Secretariat Communal de Braine-l'Alleud, whence particulars may be obtained.

Birkenhead.—February 24th. Lancashire boiler and stokers for the Corporation electricity works. See "Official Notices" February 7th.

Bournemouth.—February 21st. Motor-generator for Corporation tramways. See "Official Notices" February 7th.

Bournemouth.—March 8th. Traction and arc lighting switchboards for the Corporation. See "Official Notices" to-day.

Burgess Hill.—March 12th. Offers for the construction of electricity works are invited by the U.D.C. For conditions, &c., see our "Official Notices" February 14th.

East Ham.—February 22nd. One 500-KW. c.c. generator with 800-I.H.P. engine; water-tube boilers, condensers, &c., for the U.D.C. See "Official Notices" February 7th.

Edinburgh.—March 3rd. Electric lighting installation for the third portion of the Colinton Mains Fever Hospital (600 points) for the Council. See "Official Notices" February 7th.

Elland.—March 11th. Engines, dynamos, booster and balancers, battery, switchboard, cables, crane, and condensing plant. See "Official Notices" to-day.

Fulham.—February 26th. Two 50-KW. steam dynamos and boosters, four dryback marine boilers, battery, and wiring for 2,000 lights, for the Guardians. See "Official Notices" January 31st.

France.—February 28th. The French Post and Telegraph authorities in Paris are inviting tenders until the 28th inst. for the supply of 10 tons of galvanised iron wire 1 mm. in diameter, 80 tons ditto. 3 mm. diameter, 80 tons ditto. 4 mm. diameter, and 310 tons ditto. 5 mm. diameter. Tenders are to be sent to Le Sous Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris, whence particulars may be obtained.

Germany.—February 28th. The Prussian State Railway authorities in Hanover are inviting tenders for the supply of 440 kilometres of metallic cable, 387 kilometres of galvanised iron wire, 1,220 kilometres of copper wire, and 58,500 porcelain insulators. Particulars may be obtained from, and tenders are to be sent to, Die Königliche Eisenbahn Direction, Hanover.

Glasgow.—February 21st. Switchboard extensions for the Corporation. See "Official Notices" January 31st.

Ilford.—March 24th. Cars, trucks, motors and equipments. See "Official Notices" to-day.

Islington.—February 26th. Tubular well and pumping gear, at the electricity works. See "Official Notices" February 7th.

King's Lynn.—February 21st. A Lancashire boiler and piping for the electricity works. See "Official Notices" February 7th.

Leeds.—Concentric (high tension), two-phase (low tension), and L.T. triple-concentric paper cables for the electric lighting department. See "Official Notices" January 31st.

London.—March 4th. The L.C.C. is wanting tenders for 100 or 50 double-deck double-bogie tramcars for conduit lines in South London. Drawings, &c., at the County Hall, Spring Gardens, S.W. (£3).

Maidenhead.—February 25th. Easy wiring proposals are invited by the E.L. Committee from firms willing to undertake the work. See "Official Notices" February 14th.

Manchester.—March 1st. Corporation Tramways Committee advertises for life guards for tramcars, &c.

Manchester.—March 3rd. The Rivers Committee invites tenders for electrical goods, &c.

Manchester.—March 10th. Corporation wants tenders for electrical equipments and trucks for cars. See "Official Notices" to-day.

Oban.—March 7th. Piping, balancing transformers, and motor-generators, battery, switchboard, arc lamps, cable work, and crane for the Corporation electric lighting. See "Official Notices" February 14th.

Oban.—March 7th. Conduits, manhole covers, arc lamp-posts, &c. See "Official Notices" to-day.

Pontypridd.—March 7th. Overhead equipment and bonding for the U.D.C. tramways. See "Official Notices" February 14th.

Rochdale.—February 25th. Traction switchboard and accessories, for the Corporation. See "Official Notices" February 7th.

Rockhampton (Australia).—March 31st. The Council of the Municipality of Rockhampton is prepared to consider applications from companies desirous of undertaking the construction and working of a system of electric tramways under the Queensland Tramways Act of 1882, and the Amendment Act of 1890. See Electrical Review, January 10th.

Salford.—March 1st. Twelve months' supply of materials for the Electricity Department, including cables and accessories, fuse boxes, meters, joint boxes, carbons, &c. Mr. C. D. Taite, borough electrical engineer. See "Official Notices" to-day.

Salisbury.—March 4th. The directors of the L. & S.-W. Railway want tenders for the electric lighting of Salisbury station. See "Official Notices" February 14th.

Southend-on-Sea.—March 6th. Tenders for two storage batteries. See "Official Notices" to-day.

Stalybridge.—March 3rd. Rails, points, crossings, tie-bars, bolts, trolley wire, &c., for the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board. See "Official Notices" February 14th.

Sunderland.—February 28th. Lathe, drilling, and shaping machines, and other workshop tools for the Corporation electric lighting department. See "Official Notices" Feb. 14th.

Swansea.—March 8th. Two 600-kw. steam dynamos, &c. See "Official Notices" to-day.

CLOSED.

Bilston.—The U.D.C. has accepted the tender of the British Westinghouse Company, amounting to £5,850, for a battery of accumulators to be installed in the sub-station.

Garston.—The Garston and District Electric Lighting Company, Limited, have accepted the tender of the Electrical Power Storage Company, Limited, for the storage battery for their Gateacre station at £1,010.

Hornsey.—The Council at their last meeting accepted the following tenders:—

Section E, Pipework, John Spencer, Limited	.. ..	£2,147 15 0
„ N, Mechanical coal-handling plant, The Temperley Transporter Company	.. ..	748 0 0

Huddersfield.—The tender of Messrs. E. Nuttall and Sons, of Trafford Park, has been accepted by the Tramways Committee for the conversion of the 14 miles of lines, at present worked by steam power, for electric traction. The contract price is £16,413. Other tenders accepted are:—Copper bonds, Forest City Electric Company, at £408; renewal of car wheels for 12 months, British Wheel Company; copper bonds, R. W. Blackwell & Co., at £160.

Lancaster.—The Corporation has accepted tenders for generating plant as follows:—Four high-speed steam dynamos, motor-generator and balancer, traction and lighting switchboard, British Westinghouse Company, Limited, £12,316; Lancashire boilers, piping, condensers, &c, Joseph Foster & Sons, Preston, £2,851 12s. (excavating, &c., £60); crane, J. Carrick and Sons, Limited, Edinburgh, £329.

Electric Power Station.—Masons' work, Mr. W. Harrison, £2,104; joiners' work, Messrs. James Hatch & Sons, £526; plumbers' and glaziers' work, Mr. H. P. Calvert, £129 19s.; painting, Mr. G. Stephenson, £69 8s. 1d.; slaters' and plasterers' work, Messrs. R. Hall & Son, £235 2s. 11d.

Llanelly.—Messrs. R. Alger & Sons, of Newport, have secured the contract for the electric lighting installation at Llanelly docks.

London.—The London County Council had before it on Tuesday a report by the Highways Committee in reference to the tenders received for the supply of about 3,250 tons of track rails, 1,850 tons of slot rails, 670 tons of conductor rails, 125 tons of fish-plates, 155 tons of sole plates, together with the bolts and nuts and other accessories, which are required for further sections of the tramways. The following is a list of the tenders:—

	Place of manufacture.	£ s. d.
P. and W. Maclellan, Limited, Glasgow	Société Anonymé des Acieries D'Angleur, Tileur by Liege, Belgium	41,709 10 10 or, with special locknuts 41,742 4 4
Bolling & Low, London	Phœnix Works, Ruhrort, Belgium	42,897 10 0
Edward Le Bas & Co., London	Ougree Works, Belgium	42,935 0 0
P. and W. Maclellan, Limited, Glasgow	Barrow Hæmatite Company's works	50,463 15 0
Bolckow, Vaughan & Co., London	At the Company's works	51,188 8 9
Walter Scott, Limited, Leeds	Leeds Steel Works	52,587 10 0
J. F. J. Peeters & Son, London	At the firm's works (apparently)	58,381 5 0

The Highways Committee mentioned that five other tenders were received, but these had not been considered, as they were not for the supply of all the materials required. The first three tenders were for rails made in Belgium, the others were for English manufactures, and the difference between the highest of the first three tenders and the lowest English offer was £7,500, while the difference between the lowest of the English and foreign tenders respectively amounted to £8,700, equal to about 18 per cent. The committee stated that the quantity of rails specified for in the tenders under consideration would, at the rate to be paid under the contract recently entered into for rails required for the Tooting lines, cost about £59,000, but in that case it was decided only to accept rails of British manufacture. The tender of Messrs P. and W. Maclellan was the lowest; their proposals as regarded times of delivery—namely, 615 tons within 14 weeks from receipt of order, and 225 tons per week afterwards—were satisfactory, and the Committee thought that their tender, including special lock nuts, should be accepted for the sum of £41,742. The Committee submitted a recommendation to this effect, and also asked the Council to permit the company to sublet the contract to the Société Anonyme des Acieries d'Angleur. The consideration of the recommendation was adjourned until next week.

The London County Council has accepted the tender of Jackson Bros. for the wiring and fittings required at the Bishopsgate and Manchester Square fire brigade stations for £159 7s., and £177 8s. 6d. respectively.

Middlesbrough.—The Council at their meeting on 11th inst. accepted the following tenders:—

Section A, Engine house plant, Witting Bros., electrical engineers and contractors, Limited	.. ..	£2,833 0 0
„ B, Switchboard panels, Nalder Bros. & Thompson, Limited	.. ..	490 13 4
„ C, Condensing apparatus and pipework, Crompton & Co., Limited	.. ..	314 10 0
„ D, Feed pump and economiser, Mather & Platt, Limited	.. ..	375 0 0
„ — Mains extension, British Insulated Wire Company, Limited	.. ..	867 8 4

Newcastle-on-Tyne.—The Corporation has accepted the tender of the Electrical Power Storage Company for the storage battery for its generating station at £5,277 18s.

Pontypridd.—The U.D.C. has accepted the following tenders:—

Boilers: Messrs. Babcock & Wilcox, Limited	£5,611 2 0
Engines: Messrs. Coombe, Barbour & Co., Belfast ..	5,210 0 0
Dynamo: Messrs. Greenwood & Batley	3,401 0 0
Balancer: The British Westinghouse Company	760 0 0
Switchboard, &c.: Divided between Messrs. Ferranti and Messrs. Kelvin & White	2,473 0 0
Fitters' shop: Messrs. Newbolds	594 0 0
Travelling crane: Messrs. Clarke	455 10 0
Arc lamps: Messrs. Johnson & Phillips	788 5 0

Total £19,292 17s. There were 341 tenders.

West Ham.—The following is a list of tenders submitted for the supply of four sets of surface condensing plant for the Corporation Electricity Works:—

	Price.	Alt. price.
G. & J. Weir	£5,480	—
Mather & Platt	6,300	£6,065
W. H. Allen, Son & Co. (accepted)	6,580	6,400
Do. do.	6,220	6,040
G. Fletcher & Co.	6,650	6,507
Do. do.	7,655	7,512
The Klein Engineering Company	7,040	6,940
Do. do.	7,700	7,600
Do. do.	7,995	—
J. Abbott & Co.	7,250	7,035
Cole, Marchent & Morley	7,650	8,054
Do. do.	8,090	8,494
The Pulsometer Engineering Company	7,576	7,708
Davey, Paxman & Co.	7,896	7,688
D. Stewart & Co.	8,758	8,604
The Worthington Pumping Engine Company ..	8,906	8,646
Do. do. do. ..	7,704	7,456
Do. do. do. ..	8,108	7,848
Do. do. do. ..	6,908	—
Do. do. do. ..	11,700	11,440
G. de Ritter	9,050	8,310
Daniel Adamson & Co.	9,205	8,935
Babcock & Wilcox, Limited	9,277	8,708
Do. do.	8,293	7,724
Alley & MacLellan	9,100	9,300
Do. do.	9,300	9,100
J. Cochrane	9,600	9,300
Do.	9,000	8,800
The Mirrlees Watson Company	10,050	9,720
Ashton, Frost & Co.	10,050	9,800
Couper, Schwarz & Co.	11,552	11,260
Campbell & Calderwood	12,000	11,800

Southend-on-Sea.— The Light Railways Committee recommended that the tender of the Brush Electrical Engineering Company, at prices amounting to £2,645 10s., be accepted for the supply of two bogie cars with a carrying capacity of 58, and two motor cars with a carrying capacity of 38, together with accessories. An amendment was, however, carried to the effect that three bogie cars be procured at a cost of £2,225.

FORTHCOMING EVENTS.

Saturday, February 22nd.—At 12·15 p.m. Institution of Electrical Engineers (Students' Section). Visit to the Bankside Station of the City of London Electric Lighting Company, Limited.

At 7 p.m. Hartley College Engineering Society. Meeting at the Hartley College. Paper on "Polyphase Electric Currents," by Mr. Harris.

Tuesday, February 25th.—At 8 p.m. Institution of Civil Engineers. Meeting. Paper to be further discussed: "Electrical Traction on Railways," by W. M. Mordey and Bernard M. Jenkin.

Institution of Electrical Engineers (Manchester Section). Meeting. Paper by James Swinburne, on "Electrolysis."

Wednesday, February 26th.—At 7.30 p.m. Institution of Electrical Engineers (Students' Section). Meeting. Paper to be read on "High Tension Distribution," by Mr. C. E. Newton.

Thursday, February 27th.—At 8 p.m. Institution of Electrical Engineers. Meeting at the Institution of Civil Engineers. Papers on "Electric Shock and Legislation Thereon," by Major-General C. E. Webber; "Electric Shocks," by F. B. Aspinall; "Electric Shocks at 500 Volts," by A. P. Trotter.

Friday, February 28th.—At 8 p.m. Institution of Civil Engineers. Students' Meeting. Paper to be read: "Indicating High-Speed Steam Engines," by A. M. Arter.

At 8 p.m. Electro-Harmonic Concert. Ladies' night.

Saturday, March 1st.—At 3 p.m. Royal Institution. Lecture by Rt. Hon. Lord Rayleigh, F.R.S., on "Some Electrical Developments." (Lecture III.)

NOTES.

Electrical Trades Association.—At a preliminary dinner held at the Restaurant Frascati on January 17th, at which there was a large attendance, the discussion of the nature of the proposed association or club was deferred to another occasion. This second meeting was held at the same place on Wednesday, 12th inst., at which the attendance was not so large, chiefly owing to its having been called at very short notice. A committee of 12 was appointed to take into consideration the whole question of promoting a club or other organisation for social and other purposes. The following are the names of the committee, any one of whom would be glad to receive any suggestion as to the amount of support likely to be accorded to such a movement:—C. F. Quicke, Esq., president; Messrs. Crew, Hutchinson, Larkin, Lowndes, Martyr, McLennan, Mears, Reed, Richardson, Whitehouse and Willatts. The hon. secretary is Mr. F. E. Oldham, 3, Orchard Road, Highgate.

Institution of Electrical Engineers (Birmingham).—An ordinary general meeting of the members of the local section was held last week at the Municipal Technical School, when the paper read at a previous meeting by Dr. Sumpner upon "Alternate Current Diagrams" and "The Testing of Motor Losses" was discussed. At the close of the discussion Prof. R. Threlfall gave a number of interesting electric furnace demonstrations.

Dublin Master Electrical Contractors.—Last Friday evening the members of the Master Contractors' Electrical Association, Dublin, met under the presidency of Mr. John Edmundson to make a presentation to Mr. J. W. Boucher, the retiring secretary, who had been associated with it since its formation. During the evening Mr. John Irwin, chairman of the Municipal Electric Lighting Committee, said that the Corporation had adopted the Brighton scale, viz., 7d. per unit for two hours and 2½d. for every unit after, and 7d. and 1d. for motors.

The L.C.C. and the Duties of the Electrical Engineer.—At the meeting of the L.C.C. on 11th inst., the General Purposes Committee submitted a report in relation to the question of the reorganisation of the engineer's department, and in connection with the subject they had before them memoranda from the Highways and other Committees asking them to consider the respective sections of the department to which their work relates. After referring to the responsibility of Prof. Kennedy for the Tooting tramways and to the appointment of Mr. J. H. Rider as electrical engineer, the Committee mentioned that the engineering portion of the tramway staff is under the control of the tramway manager, and it seemed to them to be not only desirable but natural that the same should be the case with regard to the electrical engineer if harmony of working and comprehensiveness of management are to be secured. It is to be remembered that this official will be responsible under the manager for the practical working of the lines when reconstructed, and many of the present tramways staff will be under his immediate supervision. It therefore appeared to the Committee to be only consistent that Mr. Rider should be classed as an official in the department of the tramway manager, as is the permanent way engineer, traffic manager, &c. This policy has been adopted in Glasgow, Manchester, Liverpool and Leeds, and has been found to conduce to efficiency of service. The report proceeded to state:—

> In coming to the conclusion that it would be advisable to place the electrical engineer under the tramways manager, we realise that it will be necessary to arrange a course of procedure in the carrying out of schemes for the construction of new tramways, or the reconstruction of existing tramways, so that there may be no misapprehension as to the scope of control by the chief engineer and the tramways manager. This is necessary, inasmuch as the schemes for new tramways, or the reconstruction of existing tramways, involve engineering works such as the widening of streets, construction of subways, interference with sewers, and the alteration of the headway of bridges.
>
> The course of procedure we suggest is as follows:—(*a*) On the tramways manager submitting a proposal for a new tramway, or the conversion of an existing tramway into an electrical tramway, the proposal shall be referred to the chief engineer for report from an engineering point of view; (*b*) the manager shall prepare the drawings and specification of the electrical equipment portion of the work, and such drawings and specification shall form part of the complete plans and specification prepared by the chief engineer for the carrying out of the work; (*c*) the chief engineer shall be responsible, in consultation with the electrical engineer, as regards the electrical portion of the work, for the proper carrying out of the work by contractors, and on completion shall hand over the tramway to the tramways manager.
>
> In proposing the above re-arrangement it is not suggested that any alteration should be made in the procedure at present adopted with regard to the Parliamentary work in connection with the Council's tramways undertaking. The chief engineer would still be called upon to give evidence upon general engineering matters, and the preparation of Parliamentary plans, &c., which is now done in the Parliamentary branch of the engineer's department, would still continue to be carried out in that department.

The Committee made recommendations in order to give effect to the suggestions in the report, but the consideration was adjourned for a week.

Institution of Electrical Engineers (Glasgow).—A meeting of this section was held last week, Prof. Magnus M'Lean in the chair. The chairman explained that Colonel Crompton had arranged to give an address on electrical matters connected with the war in South Africa, but could not do so owing to the fact that the War Office had determined that no one who was employed by them on confidential scientific work should, for the present at any rate, lecture on any military subject. The discussion of Mr. John C. Ward's paper on "Continuous Current Distributing Mains" was then resumed.

The Late M. Gramme.—It is proposed to erect a monument in Paris in memory of the late M. Z. Gramme, the inventor of the dynamo which bears his name. A committee has been appointed with the view of organising a fund for the purpose.

Obituary.—We regret to learn from the *Times* that Mr. Henry Eaton, of 75, Tulse Hill, one of the pioneers of the electric telegraphs, died on February 14th, after only half-an-hour's illness. He was born on June 27th, 1829, and began his career in the service of the Electric and International Telegraph Company when 17 years of age. In 1867 the Colonial Government made application for an experienced engineer to go to Mauritius, and Mr. Eaton was selected by Mr. Cromwell Varley for the post. After three years' absence he returned to England and was at once re-engaged by his old company. He took charge of the wires of the various companies purchased by the Government, and concentrated them at the central station of the Electric and International Telegraph Company in Telegraph Street. After the completion of the transfer he was appointed superintending engineer of the Metropolitan district of the Post Office telegraphs, and continued in that position until he attained the retiring age of 65. During the whole of his service his one aim was the improvement of the telegraph and pneumatic tube systems.

L.C.C.—The Council on Tuesday decided to introduce a special clause in the forms of tender and contract for the supply of stoneware ducts for the mains and feeder cables in connection with the conversion of the tramways to electric traction. The clause was printed in our last issue.

The Council sanctioned an expenditure of £112 10s. for the purchase from the Edison & Swan Company of 2,000 32-c.p. 200-volt clear incandescent lamps for use at the Blackwall tunnel, the price working out at 1s. 1½d. each.

It was decided to employ 30 additional assistants in the architect's department in order to expedite the work of preparing the plans, drawings and specifications for the erection of the power station at Greenwich, the temporary station at Loughborough Junction and the sub-stations at Clapham and Brixton.

American Purchases.—We read that orders for 12,000 tons of pig iron have been placed by American iron manufacturers with firms in the English Midlands, and contracts for 250,000 tons of rails have also been placed here. Moreover, Messrs. Townsend and Downey, American shipwrights, are about to instal Scottish machinery to the value of £6,000 in their shipyards, the makers having undertaken delivery in six weeks, against five months offered by the best American tender. These facts appear to bear out Mr. Schwab's recent statements to the effect that the Steel Trust cannot hope to successfully compete with British and other European manufacturers except in new markets.

Nuisances!—We read in a South country journal that "the Electric Lighting Committee reported that occupiers of houses in —— Terrace had complained of the noise caused by the working

of the machinery in the central station, and the Town Clerk had been instructed to reply to them in suitable terms." We are devoured with curiosity as to the construction to be placed on the concluding sentence, and as to the manner in which the Town Clerk carried out his instructions. We have no doubt, with all respect to that official, that his idea of suitable terms would not come up to the interpretation of the station engineer.

Schmidt System.—Messrs. Easton & Co., Limited, have granted a further sub-license to Messrs. Browett, Lindley and Co (1899), Limited, of Patricroft, to construct engines to work with highly-superheated steam on the Schmidt system, Messrs. Easton retaining the sole right to manufacture the superheaters required in connection with such engines.

Personal.—Mr. J. R. Salter has been appointed engineer-in-chief to the South Lancashire Electric Traction and Power Company, Limited, and subsidiary companies, and has, therefore, resigned his appointment as chief engineering assistant to Mr. J. Clifton Robinson in connection with the London United, Bristol, and Middlesbrough electric tramway schemes.

We hear that Mr. H. G. Cheesman, of the Eastern Telegraph Company, is leaving to-day on another tour of inspection of the company's stations, and to instal the relay system at Aden, to work from Suez to Zanzibar. We wish him all success.

Mr. Andrew F. Rock has been appointed telegraph superintendent to the North Staffordshire Railway Company, in succession to the late Mr. John Neale.

We understand that Mr. Jas. Hookey, engineer-in-chief to the Post Office, will retire next month. Mr. Hookey's service covers a period of 47 years.

Lectures.—Lord Rayleigh began a course of six lectures at the Royal Institution on Saturday afternoon on "Some Electrical Developments."

Before the Dundee Society of Experimental Engineers Mr. Fred. C. Sturrock gave an interesting paper on "High Tension Electricity."

At the ordinary monthly meeting of the Bristol Society of Architects last week, a paper was read by Mr. A. H. Dykes, A.M.I.C.E., M.I.E.E., of Westminster, on "Electricity as Applied to Buildings."

E.E.R.E.V.—It has been decided to form another company of 50 men from the Electrical Engineer Volunteer Corps for service in South Africa with the Royal Engineers. The corps has already about 200 officers and men on active service.

Submarine Cable Manufacture. — The statements made in the article which we reproduce on another page will doubtless cause some surprise among cable men on this side; but no apter comment could be wished for than an article in our esteemed contemporary, the *Scientific American*, of 8th inst., entitled "The Manufacture of Submarine Cables," and descriptive of Messrs. Siemens & Halske's new cable works. The article is profusely illustrated with views of stranding, covering, and armaturing (*sic*) machines for heavy electric light and power cables, and the description mainly applies to *lead-covered* cables! Only one view of a gutta-percha press is shown, and the description of gutta-percha cable is confined to *one short paragraph!* Really, our American friends' acquaintance with submarine cable manufacture appears to be somewhat shadowy!

Electrical Exhibition.—An exhibition of electrical consuming devices is to be held at Chesterfield in April. See our "Official Notices" to-day.

Electro-Harmonic Society.—The next "Ladies' Night" Concert of the Electro-Harmonic Society will take place on Friday, 28th inst., at St. James's Hall Restaurant (Banqueting Hall). Mr. W. E. Langdon, President of the Institution of Electrical Engineers, has kindly consented to preside. The following is a list of the artistes for the occasion:—Solo vocalists—Madame Edith Hands, Mr. James Leyland and Mr. Dalton Baker; violoncellist—Mr. W. H. Squire; pianist—Mr. Alfred E. Izard; prestidigitateur—Dr. Byrd-Page; humorous recitations—Miss D. Zingler; humorous sketches—Mr. Astley Weaver.

Appointments Vacant.—An electrical engineer is wanted by the Capetown Corporation at a salary of £650 per annum; the Council for the Foreign Community at Shanghai requires the services of a chief assistant electrical engineer at a salary of 200 taels per month (about £300 per annum); a shift engineer is required at Leicester at a wage of £2 per week; mains superintendent for Oldham (£100); the Lancaster Corporation wants a clerk of works for tramways, at 3 guineas per week. See "Official Notices" this week.

Ashton-under-Lyne.—In our article on the Bermondsey electricity works last week, we referred to the alterations in the electricity and destructor works which were recommended to the Corporation by Mr. W. H. Vincent, who was formerly the borough electrical engineer. The alterations and extensions are being carried out to the design and under the supervision of Mr. Neville Appelbee, who has succeeded to the post.

THE CENTRAL STATION ENGINEER.

The second annual dinner of the Sunderland Corporation electric lighting staff took place last week, and was highly successful. During the evening a presentation was made to the borough electrical engineer, Mr. J. F. C. Snell, on behalf of the men on the staff.

We understand that Mr. Stainer Hutchins has been appointed junior assistant engineer at the Hanley electricity works.

Mr. W. S. Johnston has been appointed resident electrical engineer to the Heywood T.C., at a salary of £156 per annum.

Mr. A. E. Wilson, assistant electrical engineer at Southend-on-Sea, having resigned, the local Council has decided to engage an engineer to fill his place at a salary of £130 per annum, rising by annual increments of £10 to £200 per annum.

On Thursday last the engineering staff of the Manchester Corporation electricity works held their first annual dinner; Mr. G. F. Metzger presiding. The only guests were Councillors Dr. Bishop and Hesketh, chairman and deputy-chairman respectively of the Electricity Committee.

Dr. Bishop toasted the "Engineering Staff," and led them to understand that their efforts during the past year were heartily appreciated by the Committee. Mr. Metzger, in reply, thanked the Doctor for the compliments paid to himself and staff, and mentioned that to have their efforts appreciated was the greatest inducement they could have to stimulate them in their various duties; he also took advantage of the opportunity to thank Mr. Pearce (the deputy chief engineer) and the staff generally for their very loyal co-operation and assistance during his first year of office.

A very pleasant evening was spent, the arrangements reflecting much credit on the organising capabilities of Mr. W. F. Long, the chief assistant engineer.

NEW COMPANIES REGISTERED.

Market Drayton Electric Light and Power Co., Limited (72,677).—This company was registered on February 4th, with a capital of £15,000 in £10 shares, to carry on at Market Drayton, Salop, and elsewhere the business of electrical engineers, electricians, practical engineers and contractors, manufacturers of electrical apparatus, mechanical engineers, producers of light, heat, sound and power by electricity, galvanism or magnetism, &c. The first subscribers are:—R. C. D. Hudson, Cheswardine Hall, Market Drayton, Salop, gentleman, with 10 shares; C. W. Clifford, Red House, Market Drayton, Salop, gentleman, with 10 shares; A. W. Wycherley, Corbet Arms Hotel, Market Drayton, Salop, hotel proprietor, with ten shares; W. Arkinstall, Fernleigh, Market Drayton, Salop, brewery manager, with one share; S. Bennion, Ercall Villas, Queen Street, Market Drayton, Salop, bookseller and stationer, with one share; A. Mackenzie, Stafford Street, Market Drayton, veterinary surgeon, with one share; F. E. Harding, Old Springs, Market Drayton, gentleman, with one share; and N. Loring, Spring Hill, Market Drayton, land agent, with one share. Minimum cash subscription, £8,000. The number of directors is not to be less than three nor more than five; the first are R. C. D. Hudson (chairman), C. W. Clifford and A. E. Wycherley; qualification, £100.

Cornwall Electric Power Syndicate Limited (72,700).—This company was registered on February 6th, with a capital of £5,006 in 50 ordinary shares of £100 each, and 120 deferred shares of 1s. each, to carry on in the County of Cornwall or elsewhere the business of an electric power and power gas supply company, and the general business of electricians, electrical, metallurgical, and general engineers, suppliers of energy for light, power, heat, and other purposes, contractors, &c. The first subscribers are:—F. Harvey, Glenmore, Hayle, Cornwall, merchant, with one share; L. C. Foster, Trevellis, Liskeard, Cornwall, banker, with one share; O. Wethered, 30—31, St. Swithin's Lane, E.C., engineer, with two shares; C. Wren, 28—29, St. Swithin's Lane, E.C., managing director Tramways Syndicate, Limited, with one share; T. B. Bolitho, Trewidden, Penzance, merchant, with one share; T. R. Bolitho, Tremwainton, Penarth, merchant, with one share; G. B. Pearce, The Beeches, Hayle, tin smelter, with one share; D. Fox, Dewsbury, merchant, with one share; C. R. Crawshaw, Dewsbury, colliery proprietor, with one share; W. Bakewell, F.R.S., B.A., 38, Park Square, Leeds, architect, with one share; W. Marchant, Ashton-under-Lyne, engineer, with one share; C. A. Baker, 17, Shaftesbury Avenue, W., electrical engineer, with one share; and O. B. Thomas, 59, Chancery Lane, W.C., solicitor, with one share. Minimum cash subscription 10 ordinary shares. The number of directors is not to be less than three, nor more than 11; the subscribers are to appoint the first; qualification, one ordinary share, or five deferred shares. Registered office, 30—31, St. Swithin's Lane, E.C.

Hong Kong Tramway Electric Company, Limited (72,719). This company was registered on January 7th, with a capital of £300 in £1 shares, to construct or acquire, equip, maintain and work by electrical, mechanical or horse power, tramways, railways, boats, and other means of communication, in Hong Kong or elsewhere in Asia, and to carry on the business of suppliers of electric energy for light, heat, and power, &c. The first subscribers (each with one share) are:—G. Cawston, 56, Upper Brook Street, W., barrister; R. Miller, 132, Gresham House, Old Broad Street, E.C., East India merchant; F. A. White, Oakleigh, East Grinstead, gentleman; J. G. H. Glass, Tarnworth, Mitcham, civil engineer; P. Tarbutt, 23, St. Swithin's Lane, E.C., civil engineer; E. Davis, 27, Old Jewry, E.C., merchant; and T. Gilbert, Southport House, Carlton Road, Putney, gentleman. No initial public issue; registered without articles of association.

Associated American Electrical Manufacturers, Limited (72,775).—This company was registered on February 14th, with a capital of £1,000 in £1 shares, to adopt an agreement with A. F. Woodley, the general agent for England and Wales of the Goudey McLean Company (a company organised under the laws of the State of New York for managing the foreign sales of the products of a syndicate of American electrical manufacturers, the present members of which are the Pittsburg Transformer Company, the Milwaukee Electric Company, the Browning Manufacturing Company, the Fastoria Incandescent Lamp Company, the Keystone Electrical Instrument Company, the Safety Insulated Wire Company, the Wheeler Reflector Company, the Dayton Fan and Motor Company, the New England Electric Manufacturing Company, the Electric Motor and Equipment Company, and others), and to carry on the business of electricians, engineers, makers and suppliers of, and dealers in, electricity for power, light, and other purposes, makers of electrical apparatus, &c. The first subscribers are:—S. B. Apostoloff, 28, Bush Lane, E.C., consulting electrical engineer, 9 shares; A. F. Woodley, 28, Bush Lane, E.C., electrical engineer, 5 shares; T. Marriott, 4, Uxbridge Road, Surbiton, gentleman, 1 share; F. H. Austin, 28, Bush Lane, E.C., clerk, 1 share; H. S. Youngs, 38, Wilkinson Street, Lambeth, S.W., clerk, 1 share; A. Derry, 104, Fifth Avenue, Queen's Park, W., clerk, 1 share; and W. Luxton, 36, Macks Road, Southwark, housekeeper, 1 share. Minimum cash subscription, £100. The number of directors is not to be less than two nor more than five; the first are S. B. Apostoloff (chairman) and A. F. Woodley (managing director); qualification, two shares; remuneration, £1,000 per annum for the chairman and £200 per annum each for the others. Registered office, 28, Bush Lane, Cannon Street, E.C.

CITY NOTES.

Electric Lighting and Traction Company of Australia.

MR. J. B. BRAITHWAITE, JUN., presided at the annual meeting of this company on Monday, at Winchester House. In moving the adoption of the report, which appeared in our last issue, he commenced by remarking that Mr. R. P. Sellon, the managing director of the company, was absent in the States on urgent business. On January 11th, 1901, information was received by cable that the transfer of the Melbourne property had been effected, so that they had only had possession of the property for 7½ months during the financial year which ended on August 31st. During that time encouraging and steady progress had been made. Their anticipations that very considerable economies would be effected by the amalgamation of the two companies had been realised under the very able and successful management of Mr. Clements, their general manager in Australia During the 7½ months mentioned, there was an economy of nearly £1,000 in coal, and £1,500 in wages. They had not yet reached the point of being able to close down one of the stations altogether, but as soon as the new plant which had been shipped to Melbourne was running, the Alcock Company station could be closed down, and further considerable economies obtained. They had received the returns for the months of September, October, and November; in September the revenue was £2,888; for October, £2,777; and for November, £2,464, making a total for the three months of £8,129. The expenses in the same period were for September, £1,493; for October, £1,626; for November, £1,461, a total of £4,580. The profit consequently was for September £1,395, for October £1,151, and for November £1,003, making a total profit of £3,549, or at the rate of about £14,000 a year if you take it as an average quarter. The chairman read extracts from several letters which had been received from Mr. Clements, to show that applications for light and power supply were coming in very rapidly; in many cases the applications were for power up to 50, 70, and even 100 H.P. The speaker then went on to show by comparisons with the population of towns in England or on the Continent how extremely profitable was the field over which they had powers for 25 years. The Geelong station was not a large one; it was largely a mining town, and the station was only started at the end of May, 1901. As the accounts show, there was a loss of only £14 or £15 at the end of the financial year. The figures for the next three months, however, had shown a profit of £[illegible]. He did not known of any station in England of the same size which started out so economically as that. The speaker next referred to Adelaide, where, he said, they also thought their concession would be an extremely valuable one. They had made a considerable loss during the year, but that was due to the fact that their station was not opened at all during the period covered by the accounts. They had, therefore, to erect temporary plant both for the station and for the street lighting while their own station was erecting. This temporary plant was now discontinued, as the new station was opened at the end of 1901. The new station is a fine example of modern practice, and contains a complete equipment of the best and newest machinery obtainable. The connections already amounted to some 5,000 8-C.P. lamps, including a good number of arc lamps for street lighting, and further applications for supply were coming in at a most satisfactory rate, especially for motive power for driving fans. Adelaide had a very hot climate, so that there was likely to be a big demand for power and ventilating purposes. Mains were already being laid in the densely populated city area, but Adelaide, like Melbourne, is surrounded with important residential suburbs, where a great deal of profitable lighting will be done in the future, and they were now spending capital in mains, &c., for these districts. The business at Port Adelaide, as was foreseen, had also resulted in a loss, and it would probably continue to do so throughout the greater part of the current year. So soon as the necessary arrangements could be made, the district would be supplied by high tension current from Adelaide, and the existing small station closed down. Under these conditions it was believed that Port Adelaide would yield a profit. During the past year the capital expenditure at Melbourne, Geelong, and Adelaide aggregated about £100,000. To meet the capital expenditure of the year, they issued last July £98,000 of debentures and £50,000 of 6 per cent. preference shares. All of these were taken up, but the new issue of capital was spent, and they still owed their bankers £69,870. They therefore proposed to ask the shareholders to authorise them to fall in with their bankers' willingness to advance a sufficient sum to enable them to complete the lighting of the Melbourne suburbs and get the undertaking on a sound basis. A loan of £117,000 was proposed. That money was really given in anticipation of the proceeds of the unissued ordinary shares (£125,000). As to the past year, with only 7½ months' control of the business at Melbourne, and with neither of the stations at Geelong or Adelaide contributing, they had been able to earn the whole of the dividend of the preference shares and £2,366 which they paid in interest to their bankers. If shares had been issued, that amount would have been available for dividend on the ordinary stock, so that they really earned something on the ordinary shares, and during the current year they hoped to do much better; when they met them next year they hoped to be in a position to invite subscriptions for the balance of the ordinary shares, £125,000 at par. After a few further remarks, the Chairman moved the adoption of the report. This was carried, as were also resolutions re-electing directors and auditors, and thanking the board of directors.

Brompton and Kensington Electricity Supply Company.

THE directors' report reads:—"In submitting to the shareholders the balance-sheet and accounts for the year ended December 31st, 1901, the directors report that:—The revenue account shows a credit balance of £24,249 1s. 10d., which, with the balance of £487 15s. brought forward, makes a total of £24,736 16s. 10d. After deducting £1,183 11s. 5d. for debenture and other interest, £2,100 for interim dividend on the 7 per cent. cumulative preference shares, and £3,493 3s. 2d. interim dividend at the rate of 7 per cent. per annum for the half-year to June 30th on the ordinary shares, the directors recommend that the sum remaining, viz., £17,960 2s. 3d., be dealt with as follows:—

To credit of depreciation account	£7,000 0 0
To payment of dividend on the preference shares for half-year ended December 31st	3,500 0 0
To payment of a dividend on the ordinary shares for the half-year ended December 31st at the rate of 9 per cent. per annum, making 8 per cent for the year	4,498 9 5
Leaving a balance of .. .. to be carried forward.	2,961 12 10
Total	£17,960 2 3

The following table shows the progress of the company's business:—

Year	Equivalent of 35-watt (8-C.P.) lamps connected.	Increase in 35-watt (8-C.P.) lamps.	No. of customers connected.	Gross receipts.	Expenditure.	Net receipts.
				£ s. d.	£ s. d.	£ s. d.
1890	13,665	9,145	248	5,010 9 2	4,624 6 5	386 2 9
1891	19,388	5,723	373	8,928 3 11	6,077 14 10	2,250 9 1
1892	23,700	4,312	471	10,688 18 6	7,851 19 6	2,836 19 0
1893	28,429	4,729	599	12,063 10 10	7,832 6 8	4,231 4 2
1894	35,858	7,429	755	13,695 11 8	7,431 16 8	6,263 15 0
1895	44,162	8,304	932	15,394 16 11	8,554 0 10	6 840 16 1
1896	55,265	11,103	1,164	17,442 6 5	8,410 8 4	9,031 18 1
1897	66,364	11,099	1,416	20,810 10 1	8,777 5 2	12,033 4 11
1898	80,301	13,937	1,777	24,906 17 11	10,840 14 11	14,066 3 0
1899	95,303	15,002	2,112	30,416 13 4	12,235 16 10	18,180 16 6
1900	108,978	13,675	2,395	36,125 4 5	14,801 0 10	21,324 3 7
1901	121,212	12,234	2,650	41,1b1 4 6	16,905 2 8	24,249 1 10

As was proposed in the last report, the debenture stock has been repaid, and 8,000 preference shares and 339 ordinary shares have been issued. The premiums arising from these issues amount (after deducting expenses of issue, and the premium payable on redemption of the debenture stock), to £20,551 10s. 10d. The directors propose to apply £14,203 14s. 4d. of this amount in extinguishing the renewals suspense account, and to place the balance of £6,347 16s. 6d. to the credit of the depreciation fund, which will then stand at £30,847 16s. 6d. Mr. H. R. Beeton and Mr. R. A. Germaine retire from the board by rotation, and, being eligible, offer themselves for re-election. Messrs. Miall, Wilkins, Randall & Co, the auditors of the company, offer themselves for re-election."

Smithfield Markets Electric Supply Company.

MR. H. S. LEON presided at the meeting of this company, held last Friday at Winchester House. In moving the adoption of the report, which was published in these columns last week, he said that the total revenue was £16,746, as against £15,187 in 1900. £1,500, representing the receipt from the cold air store, was, at the request of the auditors, taken out of the gross revenue, so that the actual increase in 1901 of gross receipts was £3,058. There had been during the year another £1,000 added to the depreciation fund, which now stands at £2,000. No one who understood anything about machinery would consider that too large, and the board was anxious to go on increasing the depreciation fund if possible, and would therefore take the necessary steps to do so as the net profits of the company grew. During 1902 the items of preliminary expenses (£137) would be entirely wiped out, and they hoped that the other two items under provisional order expenses and consulting engineer's fees would also be got rid of out of the revenue. The cold air store was rapidly being built. This company was not in any way responsible for that building, nor had it any interest in the business, but they hoped that they would make more profit than £1,500 a year out of it for current when it was completed.

The table in the report showed the progress that had been made since the company started. They did not mean to let any business pass by them if they could obtain it and profitably finance it. In regard to the non-payment of dividend the board were as disappointed as shareholders at the inability of the company to pay the dividend, but the policy of borrowing money in order to pay dividends was a bad one and not conducive to the welfare of any company which pursued it. They had in the balance sheet no available money with which to pay dividends, and if they would only put prejudice or disappointment on one side, they would see the wisdom of the action of the board in that respect. The business, though small, was a good one, and was steadily if slowly increasing, and he had the greatest faith that provided it was conservatively financed, they would ultimately pull through to shareholders'

satisfaction. At the present moment they were in a sound financial position; they owed £1,000 and a few other items which they were quite capable of paying in the ordinary way. The existing plant was in a first-rate physical condition. New capital charges were always coming along as the business increased, and the board had already under consideration the advisability of superseding one of the present generating sets for a larger one. They must have a certain amount of working capital, it was absolutely essential, and at present they were very short of it. Shareholders had not taken up the second debentures offered last year at all satisfactorily. They would not issue any more debentures at 5 per cent. discount, the proper price with such excellent security ought to be a 4½ per cent. debenture at par. Shareholders would have the first chance of lending the company any money which might be desired for the extension of profitable business. The prospects of the company were sound provided that they had a free hand in the financial management.

The report was adopted, and retiring directors and auditors were re-elected.

Dublin and Lucan Electric Railway Company.

THE directors, in their report to be submitted to the shareholders at the forty-first ordinary half-yearly meeting of the company, to be held on Thursday, the 27th inst., state that the expenditure has been reduced, the traffic receipts show a considerable increase, and the general position of the company's affairs is considerably improved. After providing for debenture interest, there is a balance available of £1,036 7s. 7d. Out of this it is recommended that a dividend at the rate of 5 per cent. per annum on the pref. shares be paid, which will absorb £475, and that £200, as well as the half-yearly instalment of £100 due to the electrical contractors, be paid towards the balance due for electrical equipment, leaving £261 7s. 7d. to be carried forward. During the last three months of the half-year, goods traffic has been undertaken on a small scale. The revenue from all sources shows an increase of £360 for the half-year. The expenditure shows a decrease of £460, which is partly due to the reduced price of coal, and partly to the reduction of other expenditure.

The Charing Cross and Strand Electricity Supply Corporation.

THE report of the directors to be submitted to the meeting to be held at Savoy Hotel, W.C., on February 26th, reads as follows:—"In submitting the accounts for the year ending December 31st, 1901, the directors congratulate the shareholders on the satisfactory result of the year's trading in the whole of their areas of supply. The accounts, having regard to the provisions of the City provisional order, have now to be submitted in two parts, the first relating to the West End undertakings, and the second to the City undertaking.

The West End Undertakings.—The progress of the business in the West End areas is shown by the fact that the equivalent of 27,906 additional 8-c.p. lamps have been connected, and the units sold during the year 1901 show an increase of 31 per cent. over those sold during the year 1900. A portion of this increase is caused by the fact that the supply of the City undertaking has necessarily been given from the West End generating stations, but apart from this supply the increase has been very satisfactory, the revenue from sales amounting to £99,715 3s. 3d., an increase of 16 per cent. over the amount sold in 1900. The plant, machinery and mains have been maintained in a high state of efficiency. Twenty-seven miles of mains have been added in these areas, and the trunk mains connecting these areas with Bow are being rapidly proceeded with. The new general offices of the corporation, with the sub-station adjoining, at St. Martin's Lane, is approaching completion, and the latter is being equipped with motor-generators and battery plant to enable the company to deal with the constantly increasing demand for energy. The net earnings of the West End undertakings, as shown in net revenue account No. 5, have amounted to £46,900 10s. 3d. £10,000 was distributed as interim dividend at the rate of 8 per cent. per annum for the half-year ended June 30th, 1901, there remains a sum of £36,900 10s. 3d., which the directors propose to deal with as follows:—

Dividend on 4½ per cent. preference shares to December 30th, 1901	£11,250	0	0
To pay a dividend at the rate of £12 per cent. for the half-year ended December 31st, 1901, on ordinary shares, making with the interim dividend paid in August, 1900, 10 per cent. for the whole year	15,000	0	0
And to carry forward	10,650	10	3
	£36,900	10	3

The City Undertaking.—The expenditure on capital account amounted at December 31st, 1901, to £504,257; viz., £234,257 expended by the City undertaking, and £270,000 by the Charing Cross and City Electric Company, Limited, the contractors for the works. The progress of the business has been most gratifying to the directors, and the fact that, notwithstanding the difficulties in giving a supply, necessarily incident upon the impossibility of completing the City stations, current has been sold to the extent of £9,614 argues well for the success of this undertaking. The generating station at Bow, with machinery and plant of sufficient capacity to supply 225,000 8-c.p. lamps, is approaching completion. The trunk mains from this station to City area are completed, and the City will within the next few weeks be supplied from Bow. Distributing mains have been laid in the City to the extent of 114 miles. The sub-stations at Fenchurch Street, Upper Thames Street, and at Ludgate Hill, have been equipped with the requisite permanent motor-generator and battery plant, and are ready for furnishing supply so soon as electric energy can be transmitted from Bow. A fourth sub-station in Beech Street, Barbican, to supply the northern portions of the City is contemplated, a freehold site having already been acquired and cleared. The capacity for supply from these stations will, with the machinery already in order, be increased, before the end of the year, to 375,000 lamps, and, if necessary, in the year 1903, to 600,000 lamps. 51,836 lamps are now being supplied, and the demand continues to be satisfactory. Contracts for 20,000 lamps would have been completed during the last month had it been possible to have supplied energy, and negotiations are pending for 100,000 further lamps. The revenue account for the City undertaking shows a deficit of only £756 16s. 7d., which, having regard to the shortness of the time over which the business has been proceeding, appears to the directors to be satisfactory. This is carried to the balance-sheet of the City undertaking, and will have to be dealt with out of future earnings. Mr. G. H. Brougham Glasier and Mr. Stefano Gatti are the directors who retire by rotation, and, being eligible, offer themselves for re-election. The auditors, Messrs. O. R. Johnson and Son, also retire, and offer themselves for re-election. The whole of the recent issues of 20,000 preference shares and 20,000 ordinary shares have been taken up.

Uxbridge and District Electric Supply Company.

THE annual general meeting of this company was held at Uxbridge on Monday last week, Mr. J. F. Stilwell, J.P., in the chair. The directors' report stated that good progress had been made with the erection of the generating station, and that the laying of the mains throughout the compulsory area was nearly completed. Steps are now being taken to lay extensions of the mains on terms which the directors are advised will be remunerative. Arrangements are in progress for the wiring, at a low rental, of small houses. The directors have been able to let off portions of the freehold site not at present utilised for the generating station at rents which produce a satisfactory return on the purchase price of the entire site. The directors (except the managing director) have agreed to forego any fees until the commencement of the general public supply, and the secretary is also performing his duties on the same footing. The directors, who retire by rotation, are Alderman W. Potter and Mr. H. W. Couzens, who, being eligible, offer themselves for re-election. The auditor, Mr. R. H. F. Hitchens, retires, and, being eligible, offers himself for re-election.

The report and accounts were approved and adopted.

The MANAGING DIRECTOR then read his report.

The SECRETARY reported that Mr. Max Byng, one of the directors of the General Electric Company (1900), had joined the board of this company. Mr. Potter and Mr. Couzens were unanimously re-elected. Mr. R. H. F. Hitchens, the auditor of the company, was likewise unanimously re-elected.

The proceedings terminated with a unanimous vote of thanks to the chairman.

Westminster Electric Supply Corporation.

THE report of the directors for the year 1901, to be presented at the ordinary general meeting of the above company on February 26th, at the company's offices, states that the supply of current which, on December 31st, 1900, was provided for the equivalent of 469,589 lamps of 8 c.p., had increased by December 31st, 1901, to the equivalent of 533,462 lamps, of which approximately 8,020 lamps are due to public lighting. At the present time there are on circuit the equivalent of 540,724, and applications have been received for a further 5,996 lamps of 8 c.p. The length of roadway in which continuous-current mains have been laid now exceeds 67 miles, making about 200 miles of ways, into which upwards of 209 miles of copper (strip and cable) have been drawn. In addition, during the past year, three miles of trunk mains have been laid in the company's area to connect the stations with the Central Electric Supply Company's station at St. John's Wood. These mains represent a total of 12 miles of ways, which are estimated to be sufficient to carry a supply of energy to meet the Westminster Company's requirements for a period of 10 years. The public lighting of the district undertaken by the company has been proceeded with as rapidly as possible. There are now 599 lamps erected and in circuit, and it is expected that the whole system will be completed before the coronation. The directors are pleased to state that the public supply is considered to be extremely satisfactory. In accordance with resolutions passed at extraordinary general meetings held in December last, the directors have allotted the new issue of 30,000 cumulative preference shares of £5 each to the shareholders on the register on December 4th, 1901, and this capital will be expended in providing plant, mains, &c., necessary for the future development of the company's business, which is increasing in the most satisfactory manner, a larger number of lamps having been added during the past 12 months than in any year since the company commenced operations. An interim dividend, at the rate of 10 per cent. per annum, for the half-year ending June 30th, 1901, has been distributed. After allowing for depreciation, sinking fund, &c., the net balance available for dividend is £31,003 6s. 3d., out of which the board recommend the payment of a dividend at the rate of 11 per cent. per annum, less income-tax, for the past half-year, carrying forward a balance of £2,643. The continued high price of coal has again materially affected the profits of the year, and the very great increase in rates and taxes has also reduced the amount available for dividend.

The directors therefore consider that they may congratulate the shareholders on the rate of dividend being maintained. To provide the necessary capital for the equipment of the Central Electric Company's works at St. John's Wood, the directors have, jointly with the directors of the St. James's and Pall Mall Company, guaranteed payment of the principal and interest on an issue of £250,000 4 per cent. debenture stock of the Central Electric Supply Company, Limited. For the information of shareholders, particulars of the receipts and expenditure of that company to December 31st, 1901, are given. The works are being rapidly proceeded with, and it is expected that the Central Company will be ready to supply energy to the Westminster and St. James's Companies by the ensuing winter. In accordance with the articles of association, two of the directors, Captain Bax and J. Browne Martin, Esq., retire, but being eligible, offer themselves for re-election.

The National Telephone Company.

The report of the directors for the half-year ending December 31st, 1901, to be presented at the meeting to be held at Hamilton House on Thursday, February 27th, at 2 o'clock, reads as follows:—

"The income accrued in respect of the business of the half-year amounts to £801,495 4s. 8d., as compared with £732,093 4s. 1d. for the corresponding period of 1900, being an increase of £69,402 0s. 7d. The working expenses for the half-year amount to £444,391 13s. 8d., as compared with £404,652 16s. for the corresponding period of 1900, being an increase of £39,738 17s. 8d. The net result for the half-year (after deducting the Post Office Royalties, amounting to £73,423 2s. 3d.), is a profit balance of £283,680 8s. 9d., as compared with £255,831 5s. 8d. for the corresponding period of 1900, being an increase of £27,849 3s. 1d. The rentals carried forward for unexpired terms of running contracts amount to £730,624 18s. 2d., as compared with £696,568 5s. 7d. at the corresponding period of 1900, or an increase of £34,056 12s. 7d. Out of the available balance of £222,566 12s. shown by the net revenue account (No. 3), the board will recommend the payment for the half-year of a dividend at the rate of 6 per cent. per annum on the first and second preference shares, 5 per cent. per annum on the third preference shares, 6 per cent. per annum on the preferred shares and stock, and 4½ per cent. per annum on the deferred stock, being equivalent to 5 per cent. per annum on the ordinary shares now divided into preferred stock and deferred stock, less income-tax in all cases. The board also propose to transfer £100,000 to the reserve fund, and to carry forward the balance of £7,316 12s. *Capital Expenditure.*—The sum of £233,096 15s. 3d. has been expended on capital account during the half-year in the erection of 6,155 additional exchange and private lines, and in the construction of underground works. The important and difficult negotiations with the Post Office relating to the London telephone service having resulted in a working agreement, Mr. Forbes, for domestic and other reasons, desiring to be relieved from the heavy care and anxiety of the position he so long held as president of the company, determined to resign that office. Sir Henry Fowler, the vice-president, was elected president, and Mr. George Franklin was elected vice-president. These changes involved some re-organisation of the board, and upon consideration, Mr. Forbes decided that he would prefer to resign his seat as a director. The board felt that it was desirable that Mr. Forbes's great knowledge and experience should be available to the company, and that the shareholders would approve of the retention of Mr. Forbes's services in an advisory capacity. An arrangement has accordingly been made with him for a period of five years, under which he will receive a remuneration of £1,000 per annum, with power to commute."

Cambridge Electric Supply Company.

The tenth annual general meeting of this company was held at the company's offices on Wednesday last week. Mr. D. Munsey, the chairman, presided, and was the only director present.

The directors reported that during the year 1901 there had been added to the company's mains the equivalent of 3,737 8-c.p. lamps, making the total 34,723. The number of units supplied had been 382,224, an increase of 24,789 units. The company, after paying all charges, and placing £750 to depreciation account, had a balance of £5,019 10s. 4d., which, added to £38 10s. 10d. brought forward from last year, made £5,058 1s. 2d. An interim dividend of £1,518 16s. 10d., and interest on temporary overdraft and loan (£340 5s. 3d.), had already been paid, leaving a net balance of £3,198 19s. 1d. Out of this the directors recommended the payment of a dividend of 4½ per cent., making, with 2½ per cent. already paid, 7 per cent. for the year. This would absorb £3,080 0s. 7d., leaving a balance to carry forward, subject to fractional adjustment of income-tax, of £118 18s. 6d.

The total capital received up to the end of last year was £71,792.

During the year they expended as capital £5,270 on machinery, &c., and they had acquired 5 acres of land beside the railway at Chesterton, at a cost of £856 18s. 6d. The net revenue during the year was £40,715. They permitted their workmen to leave part of their pay in the company, and in return allowed them 5 per cent. on it; they now had £340 19s. 5d. in the company. The company's position to-day was more satisfactory than it ever had been before.

The report and accounts were carried.

The meeting was then adjourned to allow of the attendance of some of the directors before the appointment of officers could be proceeded with. Mr. Arthur Rutter offers himself for re-election as auditor. The Hon. C. A. Parsons and Mr. Simpson also go out of office (by rotation), but seek re-appointment.

Metropolitan District Railway Company.

The report of the directors for the half-year ended December 31st last, submitted to the meeting yesterday, states that the total receipts for the half-year have been £179,880; working expenses, £113,084. The revenue account shows a profit of £66,795, a decrease of £16,368. The passengers carried (exclusive of season ticket holders) numbered 18,554,240. The net revenue, after paying the interest on debentures and debenture stock, and the several rent charges, leaves a balance of £10,235. This amount will only admit of a payment for the half-year of a dividend on the 4 per cent. guaranteed stock at the rate of 15s. per cent. per annum, and leaves £185 to be carried forward. The company has during the half-year had to meet not only the competition of the Central London Railway, opened on July 30th, 1900, but also that of the electric tramways which commenced running to Acton and Kew in April, 1901, and were extended to Hounslow on the one hand and Southall on the other in July, 1901. The loss in gross passenger traffic in the year 1901, as compared with 1899, reaches the serious figure of £53,000. At the request of the Metropolitan District Electric Traction Company, the necessary notices to treat have been served upon the owners of the land required for the power house, and possession of some of the land has been secured. Arrangements are now being concluded with the London and South-Western Railway Company for the electrical equipment of that company's lines from Putney to Wimbledon, and from Turnham Green to Richmond, over which the District Company have running powers. Ealing and Harrow Railway.—Arrangements are being made to instal forthwith upon this branch an electrical system of traction which will be worked from a temporary power station. The company expects to have an electrical service of trains working from Harrow to Mill Hill Park and thence to South Acton in September next. The Metropolitan Railway Company have let the contract for the construction of the Harrow and Uxbridge Railway, and those works are now proceeding. The important extension of the District Railway from Whitechapel to Bow, which is being constructed jointly by the company and the London, Tilbury and Southend Railway Company, is expected to be ready for opening in May. Arrangements are being made for working a service of frequent trains through to East Ham. The company also hope to carry by this route a very considerable goods traffic. Brompton and Piccadilly Circus Railway.—Arrangements are being made with this company pursuant to the statutory powers for the construction of the deep level line of the District Company from Earl's Court to South Kensington authorised by the Metropolitan District Railway Act, 1897. The Brompton-Piccadilly Company have let their contracts for the construction of their railway, and are now acquiring the necessary land. The following Bills affecting the company's interests have been introduced into Parliament, and were submitted for approval at the company's Wharncliffe meeting:—(1) The Metropolitan District Railway Bill. (2) The Whitechapel and Bow Railway Bill. (3) The Metropolitan Railway Bill. (4) The Charing Cross, Euston and Hampstead Railway (No. 3) Bill. (5) The Great Northern and Strand Railway Bill. The board reports that since the last half-yearly meeting, Mr. J. S. Forbes had resigned the position of chairman, which he has held for the long period of 29 years. The board desires to place on record its appreciation of the services which Mr. Forbes has so long faithfully rendered to the company. Mr. Forbes has consented to serve the company as advisory director for a period of four years.

Edwards Air Pump Syndicate.

The report of the directors for 1901, to be presented to the meeting to-day, states that the royalties booked during the 12 months show an increase of over 10 per cent. on the previous year. The expenditure of the year shows a slight increase of £95. The steady expansion of the business of the syndicate continues both in respect to marine pumps and pumps for land installations, the former representing 58 per cent. and the latter 42 per cent. of the total number of pumps booked. A very satisfactory feature of the past year has been the large increase in the number of pumps built under license abroad. The pump has now been fitted for the condensing plants of over 60 of the most important electrical stations in the United Kingdom. Numerous inquiries are being received from South Africa and Australia. More than 1,450 pumps are now at work or in course of construction. The balance on the revenue account for the year amounts to £2,171, and adding the balance carried forward from last year, £375, there is together £2,547. The directors propose applying this balance as follows:—To sinking fund account for redemption of cost of acquiring patents, £1,250; to pay a dividend of 5 per cent. on the called-up capital, £1,050; leaving to be carried forward £247.

Scarborough Electric Supply Company.

The annual report shows that the company has 702 consumers, which is an increase of 110. The total revenue has been £8,847, as compared with £7,788. The accounts show that after placing £600 to depreciation account the balance available for dividend is £4,119, from which the directors recommend a dividend of 7 per cent. It is added that further capital will be required in 1902, but probably not to so large an extent as in 1901. Alluding to the proposed introduction of tramways into the borough, the report states that if satisfactory arrangements can be entered into with the promoters the enterprise will be of advantage to the company, whose interests are having the careful attention of the directors.

Stock Exchange Notices.—The Committee has ordered the under-mentioned to be quoted in the Official List:—City of London Electric Lighting Company, Limited—£200,000 4½ per cent. second debenture stock, in lieu of the provisional certificates now quoted.

The Charing Cross and Strand Electricity Supply Corporation.—Dividend warrants on the 4½ per cent. preference shares of this corporation were posted to the shareholders on February 15th.

The Brush Electrical Engineering Company.—The transfer books of the first debenture stock will, in view of interest payable on March 1st, 1902, be closed from February 17th, 1902, to March 1st, 1902.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending Feb. 14th were £517; corresponding week last year, £534; decrease, £17. Total to date, £3,877; corresponding period last year, £3,593; increase £484. Miles of track open, 10½.

Blackpool and Fleetwood Tramways.—The receipts for the week ending February 15th were £138; corresponding week last year, £136; increase, £2. Total receipts to date, £1,021; corresponding period last year, £950; increase, £71.

Bristol Tramways and Carriage Company.—The receipts for the week ending February 14th were £3,680; corresponding period last year £3,574; increase, £306.

Central London Railway.—The receipts for the week ending Feb. 15th were £6,732; corresponding week last year, £6,131; increase, £601. Total receipts to date, £46,145; corresponding period last year, £42,838; increase, £3,307. Miles open, 6.

City and South London Railway.—The receipts for the week ending Feb. 16th were £3,144; corresponding week last year, £2,047; increase, £1,097. Total receipts to date (7 weeks), £21,312; corresponding period last year, £14,084; increase, £7,228. Miles open, 6¼; last year, 4¾.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending February 7th:—

Company.	Amount £	Comparison with corresponding week of last year. + £	Comparison with corresponding week of last year. — £	No. of weeks.	Aggregate. Amount. £	Aggregate. Inc. or Dec. + £	Aggregate. Inc. or Dec. — £
Croydon*	607	452	—	5½	3,432	2,254	—
Devonport	340	—	—	5½	2,085	—	—
Dudley—Stourbridge	580	171	—	5½	3,224	629	—
Gateshead ..	629	—	—	5½	3,348	—	—
Greenock-Pt. Glasgow	357	190	—	5½	1,896	958	—
Hartlepool	151	4	—	5½	9.0	7	—
Kidderminster ..	81	12	—	5½	464	48	—
Merthyr	180	—	—	5½	977	—	—
Oldham—Ashton ..	444	54	—	5½	2,406	—	64
Poole	150	—	—	5½	931	—	—
Potteries	1,295	217	—	5½	7,155	505	—
Southport	113	20	—	5½	635	98	—
South Staffordshire†	662	105	—	5½	3,716	218	—
Swansea	345	35	—	5½	2,'05	164	—
Taunton	48	—	—	5½	270	—	—
Tynemouth	170	—	—	5½	976	—	—
Wolverhampton Dist.	117	83	—	5½	609	381	—

* Partly horse. † Partly steam.

Dover Corporation Tramways.—The receipts for the week ending February 15th were £149 6s. 0d.; corresponding week last year, £131 8s. 11d.; increase, £17 17s. 1d. Total to date, £1,123 13s. 10d.; corresponding period last year, £1,058 13s 1d.: increase, £65 0s. 9d. Miles of track open, 3. Car miles run, 1902, 5,078; 1901, 4,953. Number of cars, 1902, 12; 1901, 11.

Dublin United Tramways Company.—The receipts for the week ending February 14th were as follows:—D.U.T. Co., £3,016 6s. 3d.; D.S.D. Co., £609 10s. 10d.; total, £3,625 17s. 1d.: corresponding week last year—D.U.T. Co., £3,102 12s. 5d.; D.S.D. Co., £672 4s. 11d.: total, £3,774 17s. 4d.: decrease, £149 0s. 3d.; aggregate to date, £25,685 2s. 5d.; last year, £24,711 5s. 8d.; increase, £973 16s. 9d. Mileage worked 46.

Liverpool Overhead Railway.—The receipts for the week ending February 6th were £1,118; corresponding week last year, £1,208; decrease, £90. Total to date £9,446; corresponding period last year, £10,337; decrease, £891. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

A SHARP burst of flatness in the Kaffir Market of the Stock Exchange, induced by over-speculation, has brought about a feeling of depression in nearly all departments. Consols have a special cause for weakness in the prospect of renewed Government borrowing, and the Home Railway section is by no means cheered with the companies' reports, telling of increased charges in nearly all departments with the exception of coal. Electrical stocks and shares are content to mark time, and there is no striking movement to report in either direction. Central London Deferred is five points lower, the exact amount of the dividend deducted on February 13th being 4 per cent.

It appears that something will have to be done, and that shortly, to cope with the question of ventilation in the "Twopenny Tube." The directors are giving the subject their earnest consideration, and since they will have to study pretty closely the Board of Trade's recommendations as to fresh rolling stock—perhaps even new permanent way—it is to be hoped that the reforms can be carried out simultaneously. But while this chance of more capital expenditure is in the air, we should not press the investor to buy any of its stocks but Central London Preferred, which is a little lower this week. Waterloo and City, now *ex* dividend, is marked down a point, without bringing any more stock into the market. Great Northern and City Preferred are strong at 8⅝ upon extensive Continental purchases.

In the electric traction department Anglo-Argentines are a little easier at 4$\frac{3}{16}$, but Cape Electrics at 2$\frac{5}{16}$ have hardened on the week. A fair number of orders in Tramway Debenture stocks have come in, and business is passing in Brisbane Electric 4½ per cent. Debenture at 104, in British Electric Traction 5 per cent. Debenture at 127½, in Buenos Ayres and Belgrano 5 per cent. at 103½, while Calcutta 4½ per cent. Debenture commands 106, the shares of this last being at 13½. Of course, the feature of the week is the heavy slump in London General Omnibus stock, which has receded nearly 20 points on the lamentably bad report, showing that the concern earned a profit of only £2,205 for the final half of last year, a decline of over £45,000 as compared with the similar period of the Jubilee year. At the Road Car Company's meeting on Tuesday, the chairman vigorously inveighed against "Tubes" as means of passenger locomotion, declaring that they should be used for goods only.

When the City of London Electric dividend appeared at the rate of 5 per cent., it was found that all good effect which it might otherwise have had, had been discounted beforehand, and the same remark applies to the other electrical companies which have issued good reports, as, for instance, the Brompton and the Westminster. The former undertaking, which has increased its dividend from 6 to 8 per cent., shows nothing of sensational brilliance in its figures, and the number of customers during the year has only been increased by 355. The revenue is advancing slowly, but very steadily. The Westminster Company has had special expenses in its coal and rates bills, but seeing that it will be in the thick of Coronation illuminations, the outlook is as bright as that of an electric lighting company ought to be. St. James's and Pall Mall are *ex* dividend. Edmundson's of both classes are up to £6 middle, and Charing Cross Preference remain unchanged despite the deduction of the dividend.

The National Telephone Company's report, considering the stirring times through which the concern has lately passed, is a deadly dull document. The profit goes on expanding, but there is hardly any reference to the probable position of the company when its license shall expire. The prices of the stocks are, if anything, somewhat lower on the week. The Deferred is quoted at 60 to 63 and the Preferred at 97 to par. There is no recordable change in other telephone descriptions, which keep steady.

The Telegraph market is sinking into insignificance again, and after the smart reactionary rise which took place earlier in this month, a pause has been called. Prices, however, do not show any particular inclination to ease off, except in the Anglo-American group. Direct United States shares are ¼ down; the Anglo varieties are also slightly lower, after making allowance for the dividends. Signor Marconi is making himself so conspicuous over the pending visit of the German Crown Prince to the United States that some revival of the wireless telegraphy nervousness is being felt. Eastern Ordinary displays no change, and it is thought that the reduction of the cable rate will result in so much additional business that its effect will be only good.

In the Miscellaneous section, a 20s. rise in Henley's has lifted the shares to 18½, and it is rather surprising that Callender's should not have followed suit so far. The two concerns are now nearer amalgamation than ever they were. British Insulated Wire are pursuing their usual erratic course, and are up again to £10 this week on fresh reports as to an agreement with the Telegraph Manufacturing Company. The manufacturing department, on the whole, is steady, with little business doing to move quotations in either direction.

The new Dudley, Stourbridge and District Debenture issue, fathered by the British Electric Traction Company, appeals to a certain class of investor, but there is not likely to be much market in the stock.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation Feb. 12th.	Closing Quotations Feb. 19th.	Business done during week ended Feb. 19th. 1902. Highest.	Lowest
82,300	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3½— 4½	3½— 4½	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	70 — 80	70 — 80	78¾	78½
804,720	Anglo-American Telegraph	Stock	73/6	3½%	61s.	51 — 53	49 — 51 xd	50¼	...
3,097,640	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	95½ — 96½	93 — 93 xd	95	92⅝
3,097,640	Do. do. Deferred	Stock	£1 7s.	5s.	2s.	8 — 8½	7½ — 8 xd	8 3/16	8
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	...	3½— 4	3½— 4	...	...
13,333,300$	Commercial Cable	$100	8 %	...	...	165 —170	165 —170	...	...
1,741,029£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	96 — 99	96 — 99	98	...
16,000	Cuba Telegraph	10	7 %	...	...	5 — 6	5 — 6	...	...
6,000	Do. 10 % Pref.	10	...	...	...	13 — 14	13 — 14	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	8½ — 9½	8½ — 9½	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	98 —102	98 —102	...	...
60,710£	Direct United States Cable	20	3½%	3¼%	...	10¼— 10⅜	10 — 10½	...	...
101,300£	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 — 102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	134 —139	134 —139	137½	134
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	90 — 92	89 — 91	91⅛	90½
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	109 —113	109 —113	...	...
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	...	13¼— 14	13¼— 14	13⅜	13 7/16
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	109 —114	109 —114	...	..
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5¼%	...	...	99 —102	99 —102	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103 %	100 —103	...	...
180,227	Globe Telegraph and Trust	10	5¼%	5¼%	...	9½— 10	9½ — 10 xd	9 13/16	9⅝
180,042	Do. do. 6 % Pref.	10	...	...	...	13½ — 14½	13½ — 14 xd	14⅛	13½
150,000	Great Northern Telegraph, of Copenhagen	10	...	15 %	...	28 — 30	28 — 30	...	...
75,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —103	99 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	...	38 — 42	38 — 42	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	102 —105	102 — 105	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	2½%	...	...	¼— ½	¼— ½	...	..
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	...		¾— 1	¾— 1	...	..
590,000	National Telephone, 1 to 590,000	5	5 %	5 %	5 %	3⅝— 3⅞	3⅝— 3⅞	...	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4¾— 5	4¾— 5	...	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	93 — 96	93 — 96	94½	...
500,000£	Do. 4 % Deb. Stock Red.	100	...	4 %	4 %	101 —105	101 —105	101½	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	...	⅞—1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's...	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,303	Submarine Cables Trust	Cert.	...	...	...	119 —125	118 —124	...	...
58,000	United River Plate Telephone	5	7 %	...	...	4¾— 5¼	4¾— 5¼	...	...
40,006	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4½— 5	4½— 5	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	102 —105	102 —105	...	...
155,600	West African Telegraph, 5 % Debs....	100	...	...	...	100 —103	100 —103	...	..
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ⅜	⅛— ⅜	..	..
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	13 — 13½	13 — 13½	13⅜	13 1/16
75,000£	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	102 —105	102 —105	...	..
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	100 —103	100 —103	...	...
88,321	West India and Panama Telegraph	10	5%	...	...	⅝— ¾	⅝— ¾	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5½ — 6	5½ — 6	5½	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3½ — 4½	3½ — 4½	...	.
80,000£	Do do do 5 % Debs., Nos. 1 to 1,800	100	...	...	...	100 —103	100 —103	...	

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord. ...	1	...	...	...	⅜— ⅝	⅜— ⅝	...	...
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	...	...	...	100 —105	100 — 105	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	8 %	9½— 9¾	9½— 9¾	9 9/16	9¼
20,000	Do. do. 7 % Cum. Pref....	5	...	...	...	9 — 9½	9 — 9½	...	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	8½— 9½	8½— 9½	9¼	9
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼— 5⅜	5¼— 5⅜xd	5½	5⅜
250,000	Do. do. do. do. 4% Deb. Stock Red.	100	...	...	...	103 —105	103 —105	104¾	103½
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	5½%	...	5 — 5½	5 — 5½	5¼	5⅛
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —112	109 —112	111½	109⅜
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	4 %	0 %	5 %	9½— 10½	9½— 10½	10	9 13/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12 — 13	12 — 13	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	123 —128	123 —128	...	...
200,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	101 —104	101 —104	..	..
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	...	8½— 9½	8½— 9½	9¼	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12 — 13	12 — 13	...	...
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	..	106 —109	106 —109	108¼*	107½
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	...	5¾— 6¼	6 — 6½	...	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5¾— 6¼	6 — 6½	6¼	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	105 —108	105 —108	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11 — 12	11 — 12	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1⅛— 1⅜	1⅛— 1⅜	..	...
49,840	Do. do. do. do. 6 % Pref.	5	...	...	...	4 — 5	4 — 5	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	95 —100	95 —100	...	.
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	...	15½— 16½	1⅝— 16½	15⅝	15½
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	111 —115	111 —115	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	93 —101	98 —101	...	...
8,652	Notting Hill Electric Lighting	10	7 %	7 %	...	15 — 16	15 — 16	15⅝	15 9/16
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15½— 16½	15 — 16 xd	15 1/16	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8 — 9 xd	8⅛	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	97 —100	98 —101	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	1¾— 2¼	1¾— 2¼	1 1/16	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90 xd	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	..	2 — 2½	2 — 2½	...	...
109,518	Westminster Electric Supply, Ord.	5	13 %	10½%	10½%	12 — 13	12 — 13	...	...

* Subject to Founders Shares.
† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
§ Dividends paid in deferred share warrants, profits being used as capital.
¿Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation Feb. 12th.	Closing Quotation Feb. 19th.	Business done week ended Feb. 19th, 1902. Highest	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	† 10	...	...	...	4½ — 5½	4½ — 5½	...	...
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	88 — 92	88 — 92	89	...
62,074	British Electric Traction	10	8 %	9 %	...	14 — 15	14 — 15	14 7/16	14 3/16
90,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12½ — 13	12¼ — 12⅜	12⅝	12 9/16
600,000£	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	127¼	126⅜
70,000	British Insulated Wire Ord.	5	20 %	15 %	...	8½ — 9½	9½ — 10⅛	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5⅝ — 6¼	5⅝ — 6¼	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	...	¾ — 1	¾ — 1	...	...
50,000	¶ „ „ „ 6 % Cum. Pref.	£1	...	6 %	...	20s. to 21s.	20s. to 21s.	...	...
105,731	Brush Elecl. Enging., Ord., 1 to 105,731	2	5½%	5 %	...	1⅜ — 1⅝	1⅜ — 1⅝	...	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	...	2 — 2¼	2 — 2¼	...	...
125,063£	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	102 —105	102 —105	...	...
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	97 —100	97 —100	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	...	16½ — 17½	16½ — 17½	17¼	17
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6	...	...
90,000£	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	111 —115	111 —115	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	4 %	106 —109	103 - 106 xd	105½	104
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	4 %	106 —109	103 - 106 xd	105¾	104½
440,100	Do. do. Def. do.	Stock	...	...	4 %	106 —109	101 —104 xd	104	102
855,000	City and South London Railway	Stock	1½%	1½%	2 %	65 — 68	65 — 68	68	66½
47,500	Do. do. Ord. shares Nos. 22,501 to 70,000 ...	10	...	...	...	6½ — 6⅝	6 — 6½	...	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	7½%	8 %	...	3 — 3⅛	3 — 3½	3¼	...
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —104	99 —104%	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½%	...	⅛ — ⅜	⅛ — ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½%	...	2 — 3	2 — 3	...	...
344,023£	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	78 — 83	78 — 83	...	...
100,000£	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	83 — 88	83 — 88	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1½ — 2	1½ — 2	..	...
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2½ — 3	2½ — 3	...	...
182,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	97 —101	97 —101	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	9⅜ —10¼	9⅜ — 10¼	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	99 —102	99 — 102	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	...	17 — 18	18 — 19	18¼	17⅜
35,000	Do. do. do. 4½ % Pref.	5	4½%	4½%	...	5½ — 6	5½ — 6	...	...
50,000£	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	112 —116	112 —116	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	...	...	21 — 22	21 — 22	21 13/16	21 1/16
300,000£	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100 —103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¾%	3¼%	1½%	5⅛ — 5⅜	5 1/16 - 5 3/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5	...	..	11¼ - 11⅜	11 — 11½	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500 ...	10	...	...	...	15½ — 16½	15½ —16½	..	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	6 %	...	... — ...	19/- to 20/-		
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	20 %	37 — 40	37 — 40	3 1/2	38
150,000£	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	102 —104	102 —104	...	...
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	5	12 %	12 %	...	10½ — 11½	10½ — 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000 ...	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	92 - 95	91 — 94 xd	93⅛	92⅝

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance 2/—4/-
National Electric Free Wiring, 17/6 paid, ¼—¾.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16.
Do. do. Pref. (£10 pd.), 10½—10¾.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 3 per cent (February 6th, 1902).

MARKET QUOTATIONS, Wednesday, February 19th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	29/-	29/-	..
a „ Oxalic	per cwt.	32/-	32/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	89/-	89/-	..
a Ammonia, Muriate (crystal) ..	per ton	£88 10	£88 10	..
a „ „ ..	per ton	£90	£90	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a „ (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£20 10	£20 10	..
a Lead, Nitrate	per ton	£24	£24	..
a „ White Sugar	per ton	£81	£81	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8d.	8d.	..
a „ Caustic (75/80%) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£85	£85	..
a Shellac	per cwt.	127 -	125/-	2s. inc.
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	£6 5	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£8	£8	..
a Bichromate, casks ..	per lb	2¾d.	2¾d.	..
METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b „ Wire, in ton lots	per ton	£224	£224	..
b „ Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £125	£75 to £125	..
c Brass (rolled metal 9" to 12") basis	per lb.	6⅞d.	6⅞d.	..
c Tube (brazed)	per lb.	8d.	8d.	..
c „ „ (solid drawn) ..	per lb.	6¾d.	6¾d.	..
c „ Wire, basis	per lb.	7d.	7d.	..
c Copper Tubes (brazed) ..	per lb.	8¼d.	8¼d.	..
c „ „ (solid drawn) ..	per lb.	8¾d.	8¾d.	..
g Copper Bars (best selected) ..	per ton	£71	£71	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£71	£71	..
g „ Rod	per ton	£71	£71	..
e „ Electrolytic) Bars ..	per ton	£63	£63	..
e „ „ Sheets ..	per ton	£75	£75	..
e „ „ Rod ..	per ton	£68	£68	..
e „ „ H.C. Wire	per lb.	8¼d.	8¼d.	..
f Ebonite Rod	per lb.	9/-	9/-	..
f „ Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/1 to 3/2	3/3	dec.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants) ..	per ton	47/10	45/7½	2s. 2½d. inc.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	47/6 to £0/-	47/6 to 50/-	..
i „ Wire, galvanised No. 8 ..	per ton	£9 5	£9 5	..
g Lead, English Ingot	per ton	£12 2 6 to £12 5	£11 15 to £11 17 6	7s. 6d. inc.
g „ „ Sheet	per ton	£18 10	..	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 15	£8 15	..
d Mica (in original cases), small ..	per lb.	3d. to 4d.	3d. to 4d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large ..	per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	11½d. to 1/2	11½d. to 1/2	..
p „ rolled bars & rods	per lb.	1/- to 1/3	1/- to 1/3	..
p „ „ strip & sheet	per lb.	From 1/2	From 1/2	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10d. to 1/-	10d. to 1/-	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i „ „ in bars		£58	£58	..
g Tin, block	per ton	£118 10 to £119 10	£115 to £11 6	£3 10 inc.
g „ foil	per lb.	1/6	1/6	..
n „ wire, Nos. 1 to 16	per lb.	1/6	1/6	..
p White Anti-friction Metals — "White Ant" brand	per ton	£85 to £65	£85 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j „ 6 lea. Flax	per lb.	5½d.	5½d.	..
j „ 8 ply 10 lbs. Russian ..	per lb.	4¼d.	4 ¾d.	..
j „ 10 lbs. Russian, single ..	per lb.	4¼d.	4¼d.	..
j „ 180 lbs. Jute rove	per ton	£16 2 6	£16 2 6	..
k Zinc, Sh's. (Vieille Montagne bnd.)	per ton	£22	£22	..

Quotations supplied by { a Messrs. G. Boor & Co. / b The British Aluminium Co., Ltd / c Messrs. Thos. Bolton & Sons. / d Messrs. F. Wiggins & Sons. / e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works / g Messrs. James & Shakspeare. (Co., Ltd. / h Messrs. Edward Till & Co. / i Messrs. Bolling & Lowe. / j Messrs. Walter H. Hindley & Co.

Quotations supplied by { k Messrs. Morris Ashby, Limited. / m Messrs. W. T. Glover & Co., Ltd. / n Messrs. P. Ormiston & Sons. / o Messrs. Johnson, Matthey & Co., Ltd / p The Phosphor Bronze Company, Ltd.

THE DESTRUCTIVE AND LETHAL EFFECTS OF HIGH-PRESSURE * CURRENTS. †

By Dr. MARGARET A. CLEAVES.

(*Continued from page* 76.)

UNNINGHAM'S experiments, in common with all others in which these points have been observed, show that a greater amperage is necessary to produce death when the current traverses the supreme nerve centres than when it traverses the heart. In his experiments, the relations were 1·1 to 1·6 in the former as against 0·3 to 0·65 ampere in the latter instance. His conclusions are embodied in the following summary :—

"1. Industrial electric currents which traverse the whole body transversely or longitudinally in sufficient intensity kill because fibrillar contraction of the heart is produced and not, as has been hitherto surmised, by producing a total paralysis of that organ or killing it outright.

"2. Such currents neither kill the central nervous system outright nor paralyse it instantaneously. Death of the nervous system from such currents is due to the total anæmia following a sudden arrest of the circulation.

"3. In rare instances, when an electric current traverses only the cerebro-cervical portion of the nervous system in considerable intensity and for a considerable length of time, it may kill by asphyxia consequent to more or less complete inhibition of the respiratory movements, which occurs chiefly during the passage of the current. No existing facts warrant the conclusion that the medullary respiratory centre is paralysed or killed in such conditions.

"4. Industrial currents are practically non-lethal to frogs and turtles, as the condition of fibrillation quickly and spontaneously disappears from their hearts after the current has ceased to pass. Such animals, of course, can be killed by the very prolonged application of a current of moderate intensity, or by one of enormous voltage and large intensity.

"5. Strong electrical currents applied to the surface of the skin affect the heart in the same manner as currents of less strength do when they are applied directly to the exposed heart.

"6. It may be possible for an electric current of enormous intensity and electromotive force to produce instantaneous death either by its disruptive action or by producing an instantaneous heat coagulation of the cellular constituents of the body. Industrial currents do not kill instantly, although as a result of their action death rapidly occurs. The experience of individuals who have recovered from severe electric shock indicates that such a mode of death is not a painful one.

"7. Spontaneous recovery of the dog's heart from fibrillation produced by strong currents is rare. Spontaneous recovery of the dog's heart from fibrillation and restoration of the arrested circulation after the external application of a strong current for two or three seconds appears not to exist.

"8. Artificial recovery of the fibrillating heart of the dog, with restoration of the circulation and recovery of the nervous system, can be accomplished by the method described in this paper, provided the duration of the shock is short and the procedure is begun immediately after the cessation of the current."

Clinical Manifestations in Electric Shock.—As the result of electric shock in both animals and man there are distinguished five stages of effects: Muscular contractions; clonic convulsions; tonic convulsions with momentary stoppage of respiration; general inhibition of respiration and of the nervous system, but without convulsion; and lastly, complete stoppage of the heart's action.

When a strong current is brought to bear upon the subject there is a strong tetanic contraction. Sometimes, not always, when the circuit is broken, a deep respiration takes place followed by an expiratory cry. In the tabulated list‡ of accidents it is noticed in but one instance (Case 4).

Cunningham describes the clinical manifestations in a case of electric shock of which he was a witness. An electrician who was on the point of removing a defective brush from the motor of a trolley car was partially beneath the car, with his right hand on the brush, when he inadvertently rested his left hand on a live rail; immediately his muscles became tetanic and he was thrown backward in an instant, thus severing his connections with the live contacts. Syncope occurred in a few moments, and during its continuance the respirations were at first rather rapid, later possibly a little slower and shallower than normal. His pulse was very soft, rapid, and slightly irregular, but soon consciousness returned. He then vomited once and was able to get up by himself, though he complained of feeling extremely weak. The next morning he stated that the prostration had persisted for about two hours and then disappeared, leaving him as well as ever. The pressure of the current in this instance was 500 volts, but, by reason of the position and nature of the contact (hand-to-hand, dry skin), the resistance was so great as to minimise the current so that probably not more than a small fraction of an ampere passed through him. These effects, Cunningham concludes, are produced as follows: As the accidental contact with the live wires, rails, brushes, &c., is made, more or less pronounced, general muscular contractions occur. Respiration may be inhibited after a deep inspiration and expiration, but is quickly resumed. From the moment the shock begins there is temporary inhibition of the heart's action accompanied by a fall in the blood pressure. After exposure to a non-lethal current of brief duration, both normal heart beat and blood pressure are soon recovered. Consecutive to diminution of the blood pressure and disturbance of the cerebral circulation, more or less syncope frequently occurs, but this is gradually recovered from and normal circulation is re-established. When a large portion of the current traverses the brain (head and back of neck contact, for example) the underlying sensory-motor centres of the brain may be stimulated to such a degree that in a few moments one or more general convulsions, quite similar in many respects to an epileptic fit, may be produced. If syncope had not been induced previously by the cerebral anæmia resulting from the lowering of the blood pressure and disturbed heart action, the onset of a general convulsion in all probability would be accompanied by complete loss of consciousness. Loss of consciousness is not confined to fatal cases, and the longer it continues the less danger is there to life. It rarely persists longer than a few minutes, but may be followed by headache for several days—possibly by vertigo. In Cases Nos. 2 and 8 (see tabulated list of accidents) loss of consciousness was prolonged, and in No. 8 not completely recovered from for 24 hours. It is very rare that sensory or motor paralysis appears as a result of an electric shock. In Case 2 (see tabulated list of accidents) there was slight sensory disturbance; in Case 10 motor paralysis, and in Case 21 both sensory and motor paralysis. Convulsions sometimes occur and seem to bear a relation to the contacts. If the energy is expended upon the supreme centres they are more apt to appear. In Case No. 2 (tabulated list of accidents) the man was blind for 45 minutes, delirious for several hours, and for several hours unable to speak. In No. 7 the pupils were observed to be dilated—a condition often noted.

In most cases no permanent ill effects appears to follow an electric shock. On the other hand, Case 10 (tabulated references) claimed to "feel better in general health" than before. This is not an unreasonable statement in view of the physiological action of an electric current in a therapeutic dose.

The following case, however, suggests the possibility of the development of traumatic neuroses from electric shock in common with other forms of injury: A workman while at work on an electric transformer, standing on a perfectly dry floor, received a shock of 3,000 volts, with 100 interruptions per second. He lost consciousness for 20 or 30 minutes, and then he was able to get up and walk to the carriage. For about two months he was treated for burns which he had received, and recovered sufficiently to resume his work. Soon afterward he developed a neurosis associated with hysteria and neurasthenia. He presented a concentric narrowing of the field of vision, clonus of the patella, irregularity of the pulse, increased reflex action and muscular irritability, vaso-motor disturbances and weakness of the extremities. In other words, this was a typical case of traumatic neurosis developing several months after the injury.

The patient finally recovered under bromides, massage, and electricity.*

Post-mortem Findings.—The post-mortem findings in death from electricity present fairly uniform conditions:—

1. Rigor mortis is always quickly established. Tatum found it generally established in the second or third hour, but it occurred in 50 minutes in one instance. It was established in every instance without any relation that could be traced to the strength of the current. It was never absent where it was sought for, and presented nothing noteworthy in its character save promptness of appearance.

2. The extent of injury to the skin in electrical injuries and fatalities varies greatly. The points of penetration of the current are always evidenced by burns of greater or less degree. The place of exit is less frequently marked by burning than is that of entrance. The evidences of burning may be very well marked or they may be, on the contrary, very slight; and they are by no means proportional to the gravity of the accident—depending as they do upon the condition of the skin, whether moist or dry, as well as upon the nature and duration of the contacts. In Case No. 6 (see tabulated list of accidents)—pressure not given, death instantaneous—a small blister only was found on the left index finger, while in Case 14 (contact with a 2,000-volt continuous current) the thumb of the right hand with a portion of the joint was burned off. Intense cutaneous congestion and patches of ecchymosis are often found (see Cases 5 and 6, tabulated references).

3. As to the heart. Tatum found that if the body was opened immediately after a sudden death the heart was always found to be in a lax condition, both ventricles distended with blood, and both auricles pulsating rhythmically. If the examination was delayed a quarter of an hour or more, or if it followed a less rapid death, the left ventricle was sometimes found empty and more or less firmly contracted. The observations of other experimenters point to practically the same condition of the heart—that, namely, which follows death by apnœa.

4. Blood-vessels and blood: The arteries are often contracted to their smallest calibre and the blood is crowded into the very large veins of the trunk and head. There is sometimes rupture of the blood-vessels (see Case 11, tabulated references, and also twenty-fourth electrocution). Tatum found the blood in the arteries bright red if the body was opened at the end of a minute or so after death, but if the examination was delayed for a few minutes the blood was quite black. On free exposure to the air it turned scarlet as promptly as other venous blood and clotted quite normally. There

* In every instance in which authorities quoted have used the word "tension" in relation to an electric current, the writer has substituted "pressure," in order that the terminology may be exact.

† *Handbook of the Medical Sciences. (U.S.A.)*

‡ This list will be reproduced with the next portion of the article.

* Brustein, S. A.: "On the Action of the Electric Current of High Tension (Pressure) on the Human Body." Vratch, April 21st, 1901, Vol. xxii, No. 16.

is an absence of hæmoglobin from the blood in death due to electricity, as in apnœa. Great fluidity of the blood and absence of clots are marked features in death from industrial currents. Cases 6, 7, and 15 of the tabulated references are excellent illustrations of this post-mortem condition.

5. Viscera: The viscera are frequently found congested and sometimes engorged with blood (see Cases 7 and 15 of the tabulated references).

6. The nervous system does not present any gross lesions, nor have any microscopic evidences of changed conditions been found. That molecular changes which are not determinable by present methods may be found is very possible. On the other hand, there may be gross disorganisation of the brain, with destruction of the peripheral cortex and intracranial effusion of blood. The latter, with rupture of blood-vessels, was a marked feature in the twenty-fourth electrocution in the State of New York. Slight hœmorrages in the walls of the fourth ventricle and in the meningeal coverings are not rare.

Prévost and Battelli never found intracranial hæmorrhage when elevation of the temperature had been avoided, although there was sometimes hyperæmia of the meninges. In Case No. 5 of the tabulated references, there was hæmorrhage into the common sheath of the carotid and the vagus nerve on both sides of the neck, and there were also symmetrical hæmorrhages along the spinal cord.

The post-mortem findings in Nos. 5, 6, 7, 11 and 14 of the tabulated list of accidents—in which cases the examination was made at times varying from 10 hours to three days after the occurrence of the accident—may be summarised as follows:—In every instance there were marked rigor mortis and great cutaneous congestion, with patches of ecchymosis; the heart was uncontracted and empty; the blood was markedly fluid and would not coagulate; there was but little blood in the large blood-vessels; the viscera were engorged with blood. In some instances there were ruptures of small blood-vessels, and burns of greater or less severity were found on different parts of the body. In Case No. 7, the vessels of the scalp, meninges and brain were congested and full of liquid blood, and so also were the lateral sinuses. This accident from a 2,000-volt current seems to have affected the brain instantaneously, as the subject fell as in a fit; but the heart and respiration did not stop until five minutes later.

Is Death Instantaneous and Painless?—The conclusions of Houston and Kennelly, whose experiments were undertaken to answer the above question, are as follows:—

"1. That the passage of a sufficiently powerful alternating current through the body of an animal is followed by instantaneous, painless and absolute death.

"2. That consequently where electrocution is properly carried out there is not even a remote possibility of subsequent resuscitation of the criminal.

"3. That in case of accidental contact, where the current passing is not excessive, it is quite possible that death may be apparent only, and that the method of artificial respiration suggested by Dr. D'Arsonval should invariably be followed."

In the analysis which the writer has made of all the data at her command, and in the evidence furnished by experiments upon animals, by accidental contacts of man with industrial currents, or by electrocutions, there is nothing which contradicts the conclusions just stated. There may be a difference of opinion as to what is meant by instantaneous death, although the experiments of these authorities showed immediate and absolute arrest of the cardiac function.

So far as the ego is concerned, death is no doubt instantaneous, but from the physiological point of view this need not necessarily be true. Physiological death is not, judging from the evidence in many instances, established until some time after conscious death. The results of Cunningham's experiments show that all the tissues of the body, the nervous system and the heart included, are not killed instantaneously, and that the respiratory centre continues to act more or less perfectly for some moments after the cessation of a lethal current. On the other hand, in the experiments of Houston and Kennelly, the dogs, with the exception of the one in which the current was passed through the head, died instantly—*i.e.*, no cardiac movements nor respiratory effort occurred after the application of the current.

From an analysis of 19 cases the subject of severe but non-lethal shocks, Cunningham concluded that there was ample time before loss of consciousness for the recipient of the shock to become aware that he was or had been in contact with an electric current. Every one of the 19 individuals experienced some sort of sensation (for description of sensations and conditions produced from an electric shock experienced by a physician, see Case 21, tabulated references of accidents) before consciousness was lost—a sensation which was described by them as similar to that produced by catching hold of the electrodes of a small but strong medical induction coil. Usually a sensation of tremendous pressure is felt across the chest. It does not follow, however, that a lethal would be accompanied by as much sensation as a non-lethal shock. Indeed, to the writer's mind, the question of physical pain from electrocution is not only not proven by the evidence, but disproved. "With the nearly instantaneous extinction of the cerebral circulation, such a rapid and complete cessation of the functions of the cerebral cortex occurs that no time remains for sensations other than those of an electric current to be felt before the cerebral perceptive nerve centres have ceased to act." The suffering must be the mental anguish, and consequently of the same character as that experienced by the condemned criminal, no matter how death is to be brought about.

When the enormous pressures used in the industries are considered, it does not seem difficult to believe that death may be instantaneous, even from accidental contact. Continuous currents of 10 kilo-volts are sometimes used in series arc lighting—ordinarily only 3 kilo-volts are used. The ordinary limit, however, in the case of a continuous current is but 600 volts. In the case of alternating currents the pressures are very much greater, and go up to 40 or even 60 kilo-volts in the long-distance transmission of power.

In the writer's opinion, based upon an analysis of experimental work, accidents from industrial currents and electrocutions, as well as upon the experience of those who have suffered from electric shocks of varying severity, there seems to be no good reason for doubting that death from an electric current, so far as consciousness is concerned, is instantaneous and unaccompanied by any pain save the possible cerebral perception of an electric shock.

As to Spontaneity of Recovery.—Many instances of spontaneous recovery after accidental contact with industrial currents of high pressure are a matter of record. In these cases, as has been pointed out, but little—possibly none—of the current has traversed the heart, by reason of the position and the nature of the contacts. Therefore, the co-ordinate contractions of the heart are not stopped. Or if the current has traversed the heart, it may not, for some reason inherent in the individual, as suggested by Prévost and Battelli, have established well-defined ventricular tremulations; and consequently, in such a case, after the flow of the current has ceased, recovery takes place. Whether the recovery is spontaneous or is influenced by artificial respiration depends, no doubt, upon the degree of inhibition of the respiratory centre and the consequent asphyxia. If the nervous system has suffered profoundly before the current is stopped, spontaneous recovery is extremely doubtful, just as it is in profound asphyxia from other causes. In some instances, apparent death from lightning is but a condition of suspended animation, and it is, therefore, well always to practise artificial respiration in all cases of lightning stroke. But where the electrical energy has expended itself in producing a disruptive action, or mechanical lesions of vital organs, efforts of resuscitation are useless.

In Case No. 10, of the tabulated references, recovery was spontaneous; in Nos. 3 and 8, artificial respiration was practised; while in No. 2, morphine, brandy, and sinapisms to the præcordium were used. It is possible that spontaneous recovery might have taken place in all four instances.

On the other hand, when a strong current has passed through the heart—Cunningham places it at from 1 to 8 amperes—the organ goes at once into a condition of fibrillar contraction. He considers it most improbable that, after the brief passage of such a strong current, spontaneous recovery of the highly organised heart, with complete restoration of the extinguished circulation, would ever take place. As a matter of fact, he concludes, from his experiments upon fibrillating excised dogs' hearts (with artificial profusion of blood), that such recovery would never take place spontaneously in the brief interval which exists before the vitality of the central nervous system has become so reduced as to be incapable of recovery. After the arterial blood pressure has disappeared, "I have never seen," says Cunningham, "a single instance, in a series of more than 30 experiments on dogs, in which spontaneous recovery of the co-ordinated contractions of the heart, with restoration of the general circulation, occurred. The simpler the heart the more rapid the recovery; therefore the spontaneous recovery in frogs after a severe shock."

In electrocutions, Cunningham believes that if the autopsy is deferred for one hour and no signs of recovery are then manifested by the executed criminal, one may rest assured that recovery could not take place either spontaneously or by artificial means. He points out, however, that the excised heart would probably be made to beat again co-ordinately if it were perfused with blood.

(To be continued.)

THE TESTING OF MOTOR LOSSES.*

By W. E. SUMPNER, D.Sc.

(*Concluded from page* 281.)

The voltmeter v was so connected that it read the difference between the voltage v_0 of the bus bars, and v the voltage on the armature of the dynamo under test.

For constant excitation v will measure the speed of the machine, so that the kinetic energy K_0 of the revolving parts will be—

$$K = a\,v^2 \text{ and } K_0 = a\,v_0^2,$$

where a is some constant and K_0 is the value of K for the speed of the machine at which the armature gives $v_0 = 110$ volts. If during a time $t_2 - t_1$ the value of v changes from v_1 to v_2, and the diminution of energy is merely due to a loss of w watts in friction,

$$w\,(t_2 - t_1) = a\,(v_1^2 - v_2^2) = \frac{K_0}{v_0^2}(v_1^2 - v_2^2),$$

we may put—

$$w = A_0\,\frac{v_1 + v_2}{2},$$

and substituting—

$$A_0 = \frac{2\,K_0}{v_0^2}\,\frac{v_1 - v_2}{t_2 - t_1},$$

* Institution of Electrical Engineers, Birmingham Local Section, December 11th, 1901.

where A_0 is that current which, if flowing through the armature so as to oppose the friction, will just balance it and keep the speed constant.

Now—

$$v_1 = v_0 - v_1 \qquad v_2 = v_0 - v_2 \qquad v_1 - v_2 = v_2 - v_1$$

where v_1 and v_2 are the readings of the voltmeter.

Also $\frac{v_2 - v_1}{t_2 - t_1}$ is the rate of change of v per second. Calling this $\dot{v}$, we have—

$$A_0 = \frac{2 K_0}{V_0^2} \dot{v}. \qquad (9)$$

If in addition to the frictional torque there is one due to a current A in the armature, we have, according as A aids or opposes friction—

$$A + A_0 = \frac{2 K_0}{V_0^2} \dot{v},$$

or—

$$A_0 - A = \frac{2 K_0}{V_0^2} \dot{v}. \qquad (10)$$

Hence, if we make experiment with different values of A, and observe the corresponding values of $\dot{v}$, the connection between A and $\dot{v}$ will be linear for all speeds for which we can assume A_0 to be constant. This relation will give not only the value of A_0, and hence w the watts wasted in friction, but also K_0 the kinetic energy of the revolving parts at the normal speed.

In a preliminary test of the engine and dynamo running together with the field of the latter not quite fully excited, it was found that v altered from 6 to 27 volts in 55 seconds. Thus $\dot{v}$, or the voltage change per second, is 0·38.

$$\therefore A_0 = \frac{2 K_0}{110^2} \times \cdot 38.$$

But with a load current of 51·5 amperes it was found that the rate of loss of voltage was increased to 0·53 volt per second, v changing from 8 to 29·3 volts in 40 seconds.

$$\therefore 51 \cdot 5 + A_0 = \cdot 53 \times \frac{2 K_0}{110^2}.$$

Whence—

$A_0 = 130$ amperes.
$W = 14 \cdot 3$ KW.
$K_0 = 2{,}070{,}000$ watt-seconds.
$= 0 \cdot 557$ KW.-hour.

In a more complete test taken with the machine fully excited, and slowing down on open circuit, the following corresponding values of v and t were found:—

$t = 0, \quad 25, \quad 50$ seconds.
$v = 3, \quad 15 \cdot 5, \quad 27 \cdot 5$ volts.

Whence it appears that $\dot{v}$ slowly diminishes from 0·50 to 0·48 volt per second.

Taking $\dot{v} = 0 \cdot 49$, we have—

$$A_0 = \frac{2 K_0}{(110)^2} \times \cdot 49.$$

The machines were again run up to speed by the engine, the gas being then shut off from the latter. A load current of 52 amperes was taken from the armature. Observations taken over an interval of 30 seconds showed that $\dot{v}$ had been increased to 0·73 volt per second. We then have—

$$52 + A_0 = \frac{2 K_0}{(110)^2} \times \cdot 73.$$

Whence—

$A_0 = 106$ amperes.
$W_0 = 11 \cdot 7$ KW.
$K_0 = 1{,}310{,}000$ watt-seconds.
$= 0 \cdot 364$ KW.-hour.

The differences between the new values found for W and K and the former ones are satisfactorily accounted for by the difference in the speeds necessary to produce 110 volts under the two conditions of excitation of the field. As the speed does not vary greatly, the friction torque may be assumed the same in both experiments. The strength of the field is inversely as the values found for A_0, and the speed producing 110 volts varies directly as A_0.

Since K, the kinetic energy, increases as the square of the speed, and w as its first power, we must compare—

$$\cdot 364 \text{ with } \cdot 557 \times \left(\frac{106}{130}\right)^2$$

and—

$$11 \cdot 7 \text{ with } 14 \cdot 3 \times \left(\frac{106}{130}\right).$$

The former number works out to be 0·37, and the latter 11·6. The agreement is better than was expected, and is to be regarded as somewhat accidental.

Observations were then made on the dynamo alone. The engine belt was removed, and the dynamo run up to speed by passing through its armature a current taken from the bus bars through the water resistance. When the machine had nearly attained the normal speed, observations were made of the accelerating current, A, and the corresponding rate of rise of voltage, $\dot{v}$. The armature switch was then opened, and the new value of $\dot{v}$ observed.

The following numbers give one set of readings for $A = 0$:—

$t = 0, \quad 60, \quad 120, \quad 180, \quad 240$ seconds.
$v = 10, \quad 17 \cdot 5, \quad 25, \quad 32 \cdot 5, \quad 38 \cdot 5$ volts.

Whence $\dot{v}$ is 7·5 volts per minute, or $\dot{v} = \cdot 125$ volt per second.

The numbers in the table below give simultaneous readings of t, v, and the accelerating current, A, for a period of 2½ minutes.

t	v	A	$60\dot{v}$	Mean A	$\dot{v}$
0	30·5	56			
30	23·8	55	12·0	54·7	·200
60	18·5	53	9·3	50·3	·155
90	14·5	43	6·5	43·3	·108
120	12·0	34	4·0	35·7	·067
150	10·5	30			

The numbers given in the last three columns show:—

(1.) The decrease in v for successive intervals of one minute.
(2.) The average current during these intervals.
(3.) The value of $\dot{v}$.

After these readings had been taken another set of observations was made on the slowing down of the machine on open circuit. The readings taken were:—

$t = 0, \quad 60, \quad 120, \quad 180$ seconds,
$v = 10, \quad 18 \cdot 2, \quad 26 \cdot 5, \quad 34 \cdot 7$ volts,

giving $\dot{v} = \cdot 136$ volt per second.

Tabulating the results for A and $\dot{v}$, we have:—

A	$\dot{v}$	
	Obs.	Ca'c.
0	+ ·125	+ ·131
35·7	− ·067	− ·067
43·3	− ·108	− ·110
50·3	− ·155	− ·149
54·7	− ·200	− ·174
0	+ ·136	+ ·131

The constancy of the value of $\dot{v}$ found in each set of observations for which $A = 0$ shows that the difference between the first and last values in the above table is due to a real alteration in the frictional resistances during the interval. The values of $\dot{v}$ found for any two values of A are sufficient to determine—

A_0, W and K,

since—

$$A_0 - A = \frac{2 K}{(110)^2} \times \dot{v}.$$

This equation is confirmed by the fact that the values in the above table are found to follow the law—

$$23 \cdot 5 - A = 180 \dot{v},$$

the values of $\dot{v}$ calculated from this equation being given in the third column in the table. Thus, for the dynamo alone we have—

$A_0 = 23 \cdot 5$ amperes.
$W = 2 \cdot 58$ KW.
$K = 1{,}090{,}000$ watt-seconds.
$= \cdot 303$ KW.-hour.

For the engine and dynamo together the loss found was—

11·7 KW.,

or about 9·1 KW. for the engine alone. The result was afterwards confirmed by indicating the engine and dynamo running light. The loss found was in satisfactory agreement with that obtained by the electrical method.

It will be seen that if the kinetic energy K_0 at normal speed, for a particular engine and dynamo, is known, a single determination of $\dot{v}$ is sufficient to determine the frictional losses. Equation (9) shows that this loss is—

$$2 K_0 \frac{\dot{v}}{V_0} \text{ watts},$$

where V_0 is the voltage on the armature at normal speed. If an accelerating current of A amperes is passed through the armature when $\dot{v}$ is observed, the frictional loss is—

$$2 K_0 \frac{\dot{v}}{V_0} \pm A V_0 \text{ watts},$$

the + or − sign being chosen according as A opposes or aids friction.

THE CONSTRUCTION OF THE BREMER ARC LAMP.

About a year and a half ago the arc lamp of Bremer was for the first time brought upon the market. Since then the installation of the new lamps has been carried out on a large scale in Berlin and several other large Continental cities, and therefore a description of the construction of the lamp may be of interest. The first Bremer lamps, which during the World's Fair at Paris were arranged on the Eiffel Tower at a height of about 315 ft., contained

two pairs of carbons. This arrangement is not found in the lamps of medium illuminating power used, for instance, at Berlin. The latter have only two carbons, which are inclined towards each other at about 30°. The carbons are placed in two guide tubes, and slide downwards in them as far as possible under the influence of weights. Two flat grips serve the purpose of arresting the fall of the carbons; the grips pass through slots in the guide tubes. This arrangement is worked by means of electro-magnets.

The lamp works in the following manner:—On closing the circuit the current passes through a relay, since the two carbons are held fast and cannot touch each other. This relay circuit operates the mechanism for gripping and feeding. The carbons become free and slide down the guide tubes as far as a metallic support; the latter transmits the current of the lamp, the relay opens the circuits previously closed, the carbons become locked, and the weight of the metallic support causes a backward motion of the movable lever, to which it is attached. The arc, which now appears, is subjected to the effect of the differential magnetic field of the arrangement of electro-magnets already mentioned. The arc is at first blown downwards by the series coil. The lengthening of the arc causes a diminution of the intensity of the current. As the carbons burn away, the effect of the electro-magnet arranged in series becomes gradually less, and at a certain potential difference between the electrodes the relay will exert its influence anew. The carbons become free and slide down until they are separated as before. In this manner the effect of the unequal burning away of the carbons is neutralised.

Thus the operation of the regulating apparatus is based upon the changes of potential difference of the arc; it is not so good as in ordinary arc lamps, and there is always a tendency to unsteady burning of the lamp.

To cause a fan-shaped spreading of the arc a magnetic arrangement has been devised, which, at the same time, confines the arc to the points of the carbon rods. This is effected by the electro-magnet, which consists of two coils. The coils are wound in opposite directions; one is arranged in series with the arc, the other as a shunt. The ends of the carbons are placed in the inner part of the conical reflector, while all the remaining parts are arranged in the upper casing of the lamp, the appearance of which is very effective. The globe is fastened to the metal casing by means of hinge-joints.

The carbons used for these lamps contain a certain proportion of metallic salts, especially calcium fluoride. From this component results the peculiar yellow-red colour of the Bremer light. In the case of continuous current a positive carbon made according to Bremer's instructions is required, while for the negative an ordinary homogeneous carbon may be used. The forming of non-conducting slag is a difficulty inherent to the use of colouring matter, and is apt to cause occasionally unsteady burning of the lamps.

In consequence of the glowing particles of lime suspended in the main part of the illuminating power results from the wide-spread arc itself, whereas in ordinary arc lamps the greatest intensity of light comes from the positive crater. The condensed components of the arc, especially calcium fluoride, precipitate on the upper cone of the lamp, which, at the same time, serves as reflector, since the white residue always gets renewed, and remains pure. For these reasons the shadows cast by this lamp are softer in outline than those of the ordinary lamp. The illuminating power of the lamp is very great, and the warm reddish-yellow colour is very pleasing to the eye. Finally, it may be remarked that, at the present time, there are in Berlin, in the larger cafés, restaurants, and showrooms, more than 100 of such lamps in use, and, on the whole, they have proved very satisfactory.

THE SUBMARINE CABLE INTEREST IN AMERICA.*

American Cable Making Facilities.

THE *Electrical World* (New York) has compiled some details of the cost of cable making in England, compared with the wages which it is assumed would be paid in the United States for similar labour, which may be summarised as follows. The wage rate is given by the hour. Foreign submarine cable factories work two turns of 12 hours each, or one of 12 to 14 hours each, according to conditions. The American working day is 10 hours:—

	England.	United States.
Labourers ... 5d.	[10 cents]	.15 to .17½
Wire weaving ...7 to 8d.	[14 to 16 cents]	.20 to .25
Armouring ... 8½d.	[17 cents]	.25
Machinists ... 10d.	[20 cents]	.25 to .35

The labour cost of an American made cable would thus be 50 to 75 per cent. greater than in England. It is asserted further that a similar disparity exists in wages in the wire-drawing industry, and that the American tariff would preclude the importation of the more cheaply produced foreign drawn wires. The higher cost to American cable makers of copper wire is estimated at from 10 to 15 per cent., and of steel armour wire, as high as 33⅓ per cent.

It is also assumed by the writer in the *Electrical World* that, on account of the predominance of English houses in the gutta-percha trade, and their greater familiarity with it, the cost of gutta would prove greater here, at least in the beginning. Last, but not least, in order to tender for an ocean cable, which would require to be constructed without too great delay, a very large initial capital would be necessary for plant and other facilities, on a scale commensurate with those which have been built up by degrees by foreign manufacturers during a long term of years, the cost being defrayed gradually from the profits on many successive orders, small and large.

"The article in the *Electrical World* shows a careful study of the situation," said an official of an American cable company to the *India-rubber World*, "but its writer probably was not aware that at least two American factories have been quietly equipping themselves for submarine cable work. While most of the data in that article will be found sufficiently accurate, the writer overlooks the fact that in competition between European and American workmen, although the pay is much higher in this country, in nearly every case the amount of work accomplished compensates for the difference in wages. The great supremacy gained by America in the last two years in export trade, allowing us to sell locomotives, bridges, machinery, and manufactured goods abroad, successfully entering the markets that had long been controlled by England, is ample proof of my statement.

"It is stated by English cable engineers, and actually believed by them, that experts in cable manufacture are born, not made. The subject of high insulation is nothing new to Americans. The first successful submarine cable ever made was of American manufacture and laid across the Hudson river. Since that time there has never been a break in the manufacture of insulated wire in this country up to the present day, and it is only reasonable to believe that, with this long experience and the large number of American manufacturers engaged in the insulating industries—there are now 15—that our mechanics are sufficiently well educated to construct a submarine cable.

"There have been installed in this country within a short time some of the latest types of submarine cable machinery. While in Europe some time ago I obtained data regarding the largest cable plants, and found, much to my surprise, that in some respects American manufacturers were in advance of their trans-Atlantic cousins.

"The great drawback to American industries has been the smallness of their armouring plants, with the inability of a large daily output. While their insulating machines could turn out a large quantity of core, they do not have the facilities for armouring the same. As this industry is new, it is impossible to buy proper closing machines in America. It was, therefore, necessary, in installing one new plant here, to import the latest type high-speed closing machinery for this work, plans being so drawn that, in case of an American Pacific cable Bill passing Congress, they can immediately increase the number of these machines to a capacity of 30 nautical miles per day, which is five miles in excess of the best foreign factories.

"There is no question that the first Pacific cable would cost more, built in this country, than abroad. American manufacturers should be granted ample protection in the establishment of this new industry. Once established, and with the improvements suggested by American skill and ingenuity, it would be but a short time before they would enter the cable markets of the world, and, with their increased speed in manufacture, rapid deliveries, and the improvements that would surely be made, they would very soon build up a business that would allow them to compete with foreign manufacturers.

"One of the great points of advantage in an American plant would be the ability to use submarine cable-making machinery in the manufacture of land wires for telephone, telegraph and electric light work. Some of the present foreign plants are only run six months out of each year—*i.e.*, only when submarine cable is to be made. Their electrical industries do not of course require the tremendous amount of insulated wire that is used in America. Taking into consideration these economical principles, with the ability for keeping the machinery running on all forms of work, there is no question but that an American plant, when built by a company whose reputation is well established in other lines of wire manufacture, would prove a profitable investment."

With regard to the suggestion in the *Electrical World* that American manufacturers would be at a disadvantage in buying gutta-percha, the gentleman above quoted did not speak. It might be noted here, however, that although few Americans have ever engaged in the crude rubber trade in the primary markets, the rubber manufacturers here have never been at a disadvantage in getting all the raw material they needed. In fact, the *India-Rubber World* has been assured by an English rubber merchant that manufacturers on this side are "closer" buyers of crude rubber than in England. As for gutta-percha, its use in continental Europe is increasing—chiefly for cable making—and in 1900 there were shipped from Singapore direct to those countries 5,500,000 lbs, or more than the world's total production a few years before. If these countries have not been deterred by England's predominance from going into the gutta-percha trade, why should the United States be? Indeed, the cable-making industry of England was, to a certain extent, an importation from Germany, the original Siemens house having established a branch in England, before the days of free trade, to avoid paying duties on their products sold in the latter country.

* *India-Rubber World*, New York.

THE BUFFALO HIGH TENSION CABLE DISTRIBUTION SYSTEM.*

By HAROLD W. BUCK.

In the development of the electrical transmission of power many propositions are being presented of a water-power or coal mine situated within such a distance of a city that it is cheaper to transmit power from the mine or waterfall than to generate it by steam in the city itself. In such systems three engineering elements must be considered; first, the generating plant; second, the transmission line; and third, the method for distributing the power at the end of the transmission line. Electrical generating plants and transmission lines have been the subject of many discussions, but the terminal arrangements for transmission lines are newer in their development, and it is the object of this paper to bring the matter before the members of the Institute for discussion, the problem presented being the best method of distributing the power

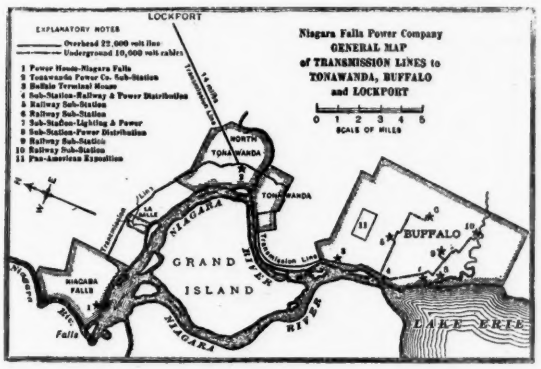


Fig. 1.

throughout a city after a point has been reached in the transmission line where it is no longer safe to carry the power overhead at the transmission voltage. Such limitations exist on the outskirts of all cities.

In order to serve as a basis for discussion, and to point out the various considerations which enter, a brief description will be given of the method which has been adopted for the distribution of Niagara power at Buffalo.

Fig. 1 shows a map of the Niagara-Buffalo transmission line, indicating the relations between the overhead circuits and the circuits of distribution within the Buffalo city limits, the numeral 3 on the map indicating the terminus of the 22,000-volt overhead

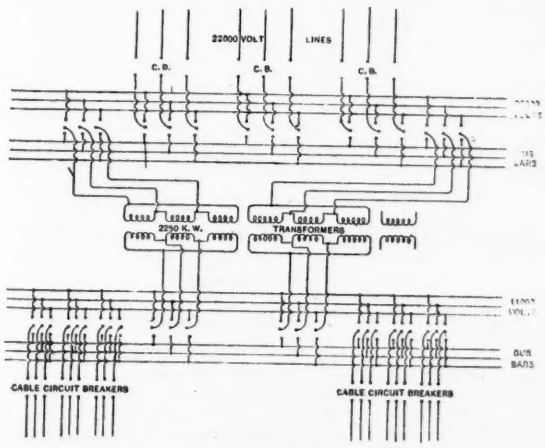


Fig. 2.—Connections, Buffalo Terminal House.

three-phase lines. At this point the three overhead circuits, each having a capacity of 10,000 h.p. at 7 per cent. line loss, enter a terminal house, and are connected, as shown in fig. 2, through circuit breakers, selector switches, bus bars, &c, to the 22,000-volt primaries of the step-down transformers. These transformers have a capacity of 3,000 h.p. each, and are of the oil-water cooled type. The secondaries of the transformers are wound for 11,000 volts, making the ratio of reduction of voltage 2:1. The secondaries of the transformers are connected through selector switches and two sets of bus bars to the underground cables, each of which is connected through an air-break circuit-breaker. With the arrangement shown, the Buffalo system can be operated in two sections if desired, and an overhead circuit or any cable connected to either of the banks of transformers. The 11,000-volt cables supplied from the secondaries of the terminal house transformers are drawn through tile ducts under the streets in the usual manner, and carry the power to the various sub-stations throughout the city of Buffalo. At present there are five feeders, each consisting of No. 000 triple-conductor lead-covered cables. Two of these have 9/32 in. rubber, two 8/32 in. rubber and one 6½/32 in. paper and 4/32 in paper overall. The lead in all cases is ⅛ in. thick.

Fig. 3 shows the general arrangements of cables throughout the city, with the various methods which are used for transferring from one to another and for cutting out damaged sections of a cable by means of section switches, so that the entire length of cable from the terminal house will not have to be cut out of service. Special attention is called to these section switches, which are shown in fig. 4. They are of the triple-pole, single-throw type of oil break switch, with a waterproof hood of iron bolted to the top of the switch frame for the protection of the cable heads and leads. These switches are installed in vaults under the city streets, placed at convenient intervals. Some of the vaults are as large as 10 × 12 ft. The switches are absolutely waterproof, and could be submerged if necessary without danger, and will open the circuits under heavy loads without difficulty. They have proved of great convenience at times when repairs have been made necessary on sections of cables, and for locating faults without the necessity of cutting the cable. I believe that underground section switches of this kind would prove of great service to all high-tension cable

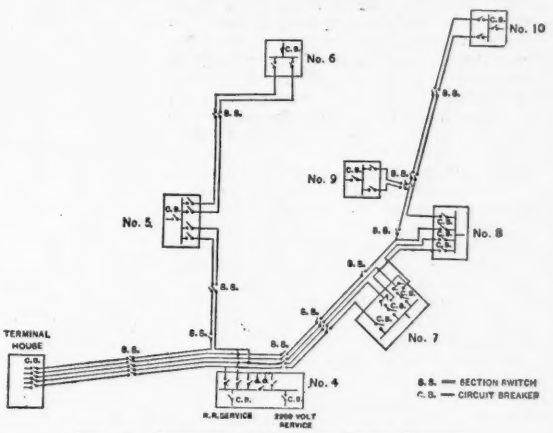


Fig. 3.—Buffalo 11,000-volt Cable System.

systems, and believe that the design shown is entirely safe for service at 11,000 volts.

In all, seven sub-stations are supplied with power at 11,000 volts, three-phase, distributed as follows with reference to fig. 3:—

Station No. 4.—2,000 h.p. for railway purposes, transformed from 11,000 volts to 360 volts and fed to four 500-h.p. rotary converters. 1,100 h.p. for general power distribution on a tertiary system at 2,200 volts, three-phase, the voltage being lowered from 11,000 volts by three 250-kw. transformers. This 2,200-volt distribution is partly overhead and partly underground.

Station No. 5.—1,500 h.p., for railway purposes, transformed from 11,000 volts to 360 volts and fed to three 300-h.p. rotary converters.

Station No. 6.—1,000 h.p., for railway service, as in Station No. 5.

Station No. 7.—5,000 h.p. is transformed from 11,000 volts to 360 volts and fed to the plant of the Buffalo Lighting Company in an adjacent building. 1,000 h.p. transformed to 2,200 volts, three-phase, for general power distribution on the tertiary system.

Station No. 8.—2,000 h.p., transformed from 11,000 volts to 2,200 volts, three-phase, for power distribution on the tertiary system.

Station 9.—1,500 h.p., transformed from 11,000 volts to 360 volts, for supplying power to three 500-h.p. rotary converters for railway purposes.

Station No. 10.—1,000 h.p., for railway purposes, as in Station No. 9.

It might be asked why the power is not transmitted from Niagara Falls at 11,000 volts and distributed through the underground cables without transformation. It will be found, however, that the saving in copper on the transmission lines by the use of 22,000 volts more than pays for the transformer installation in the terminal house, and that the saving in line loss is greater than the loss introduced by the step-down transformers. The longer the transmission line the greater would be the proportionate saving. It may also be asked why, if the overhead lines are to be operated at 22,000 volts, the transmission cannot continue at this voltage throughout the cable system in order to avoid the use of step-down transformers. It is true that there have been examples of successful operation of underground cables at voltages even higher than 22,000 volts, notably the transmission from the plant of the St. Croix Power Company, but, obviously, what can be done on a through trunk line cannot be safely done on a network, and the

* A paper read at the 158th meeting of the American Institute of Electrical Engineers (*Street Railway Review*).

Buffalo underground system is essentially a network. It has many lateral connections, frequent joints, section switches, cable heads and switchboard connections, and under these conditions, which are probably no different from the requirements of other cities, I believe that 11,000 volts is, in the present state of the art at least, the highest voltage that should be considered. The success of the Buffalo power distribution at 11,000 volts, which has covered a period of about four years, has, however, demonstrated the safety and feasibility of using a potential as high as this, provided the greatest precautions are taken in the selection and installation of cables and in the insulation of all terminal appliances. It seems to show that there is no longer any reason for fixing the prevailing voltage of 6,600 volts as the safe limit for underground work and for paying for the extra copper and ducts required by the lower voltage.

In cases of short-circuit in the cables, practically no damage is done at 11,000 volts on account of the small current. Short circuits have occurred on these cables, which have had the whole of Niagara power back of them, and it has been found, after locating the fault, that the lead was barely melted off around the fault. At 6,600 volts such a short-circuit would undoubtedly blow the cables to pieces, on account of the greater current, the heat energy at the fault being nearly four times as great. This is a practical advantage, for it reduces the risk of damage to adjacent cables and ducts.

In the city of Buffalo, then, we find a distributing company called the Cataract Power and Conduit Company, purchasing power from the Niagara Falls Power Company at the Buffalo city line, at the transmission voltage, lowering it to 11,000 volts, three-phase, 25 cycles, and distributing it as raw material in this form as dealers in power. To the railway company it is delivered for transformation and conversion for use on their own direct current circuits, to the lighting company for conversion into the various forms in which they redistribute it to small consumers, and it is also delivered to various factories using power in quantities from 75 H.P. and upwards, to which consumers power is supplied from the tertiary system mentioned at 2,200 volts, three-phase, from sub-stations owned and operated by the Cataract Power and Conduit Company.

From a business as well as an engineering standpoint, it is believed that the methods used in Buffalo as described are very satisfactory and economical. The primary company, viz., the Niagara Falls Power Company, confines its attention to the generating plant and transmission line, the distributing company to the delivery of three-phase 25-cycle alternating current power, and the railway and lighting companies to the interests of their own circuits. This separation of responsibilities is entirely logical and most convenient. It would be still better if the Cataract Power and Conduit Company could confine itself to the delivery of power at a single voltage, viz., 11,000 volts, but the tertiary distributing system at 2,200 volts is necessary, for the reason that it is obviously not safe to supply small consumers of power, such as small factories, with connections at so high a voltage. By transformation to 2,200 volts the numerous "grounds" which occur on these circuits are made independent of the main cable system, and the introduction of the transformers adds to the self-induction of these circuits and limits the violence of short-circuits which occur upon them.

The transformation of voltage at the city line from 22,000 volts to 11,000 volts, besides being necessary, is also a positive engineering advantage, for the reason that it renders the 11,000-volt cable system independent of "grounds," and high-voltage disturbances from lightning, resonance, &c., which occur at times on the transmission line, since there is no electrical connection between the two. Although there have been several instances of rises of potentials on the overhead line far above the normal, resulting probably from resonance, no rises of voltage have been noted as having been transmitted to the cables by induction through the cores of the step-down transformers.

It is believed that the methods here described are practicable and convenient, and can be safely followed in principle by those who are planning similar systems of distribution.

STARTING RESISTANCES.*

By ARTHUR E. GOTT.

EVERYONE who has had much experience with motor work must have had considerable trouble with starting resistances. Sometimes the trouble would arise from mechanical defects, but more often from electrical imperfections. It is with the electrical properties of starting resistances that this paper chiefly deals.

* Abstract of paper read before the Newcastle Local Section of the Institution of Electrical Engineers, January 13th, 1902.

The electrical imperfections of starting resistances are due to an insufficient comprehension of their functions by the manufacturers, who sub-divide the resistance between the several contacts of the switch equally, or in some way which does not take into account the fact that as the arm of the switch is moved over the contacts the speed of the motor increases, and its counter E.M.F. approaches more and more nearly to the value of the impressed potential difference.

A source of trouble in the manufacturing of starting resistances is the 10-ampere rule imposed by many corporations. Some corporations insist upon not more than 5 amperes being taken on the first point of the resistance, while even 2½ amperes is required by a few. On close inspection such rules are absurd for large motors, since the greater portion of the starting resistance has to be cut out before the motor will start at all.

In small motors having large internal resistance, no starting resistance is required, since the current at start will not greatly exceed the full load current, and that only for the short time required for the motor to speed up. Stated otherwise, no starting resistance is required when

$$\frac{\text{Pressure of supply}}{\text{Pressure of supply} - \text{back E.M.F.}}$$

is small.

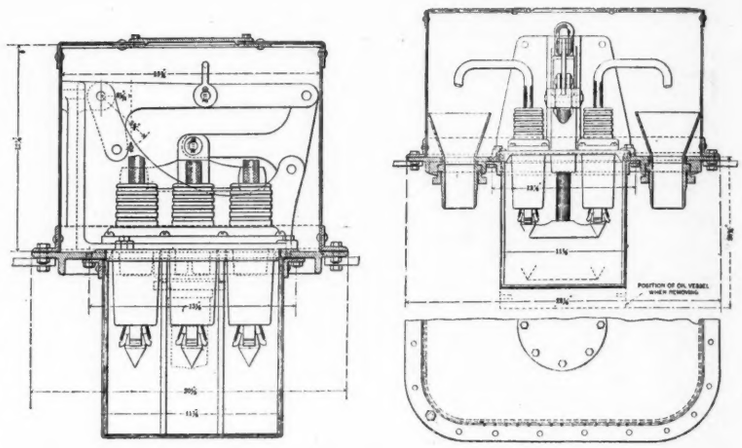


FIG. 4.—UNDERGROUND SWITCH.

Early Starters.—Many of the earlier starters had a resistance of three to six sections only, and were divided into equal sections. It is interesting to examine the behaviour of a motor with such a starter, taking, as an example, one of 12 H.P. at 110 volts starting under light load, driving shafting only, and taking 20 amperes at that load. This particular motor was provided with a fly-wheel, and the armature and brush resistance was approximately 0·07 ohm. The resistance consisted of 24 coils, each of 0·05 ohm, making with the motor a total of 1·27 ohms in circuit on the first point of the switch. The resistance was divided up into three equal sections of eight coils each. With 110 volts supply the current is 87 amperes. The motor at once runs up to a speed at which the falling current and machine resistance are balanced, and assuming the torque constant throughout, this will be 20 amperes. The back E.M.F. is then

$$\text{Pressure of supply} - (20 \times 1{\cdot}27) = 84{\cdot}6 \text{ volts.}$$

On moving the switch to the next contact the momentary current will be

$$\frac{25{\cdot}4}{1{\cdot}22} = 29 \text{ amperes.}$$

At the next point of the resistance the momentary current will be 37 amperes, while at the last point it rises to 134 amperes, or 40 per cent. in excess of the full load current. Further, the motor will be violently accelerated on the last step, with considerable slipping of the belt and sparking at the brushes.

To avoid this the resistance should be divided so as to have a gradually diminishing resistance between each step, and the best method of sub-division is to let the resistance diminish in geometrical progression with the armature resistance as one extreme and the total resistance as the other, so that

$$a f^n = \text{total resistance,}$$

where a = armature resistance; f = common factor; and n = number of sections of resistance. As an example, take a motor of 10 H.P. at 230 volts taking 38 amperes at full load with an armature resistance of 0·25 ohm. The current on moving from one step to the next is not to exceed 10 amperes. The percentage increase is therefore

$$\frac{10 \times 100}{38} = 26 \text{ per cent.}$$

and the factor to be employed is 1·26. The resistance including armature to the end of each section is therefore $a \times 1{\cdot}26$; $a \times 1{\cdot}26^2$; $a \times 1{\cdot}26^3$. . . . &c., until $a \times 1{\cdot}26^n$ = total resistance decided

upon. The difference between these products = resistance of corresponding sections in starter, the first being $a \times 1{\cdot}26 - a$. The number of sections required can be found in this way, and in this particular instance 14 sections will give a total resistance of 6·3 ohms, *i.e.*, $a \times 1{\cdot}26^{14} = 6\,3$.

Difficulties of Construction.—Now the method of geometrical dividing of motor resistance is not without its disadvantages. Owing to the different values of the resistances having different lengths and sections, there is considerable trouble in getting them into the same frame, necessitating more skilled labour than would be necessary if all the coils were alike, as great care has to be taken to connect the resistances in order in the frame.

Supply Requirements.—It is well while considering motor starters to review the various supply rules concerning the current demands of motors. Owing, no doubt, to imperfect starters lowering the volts, many rules have been formulated with a view to compelling the user to limit the current at starting to 10 amperes per section of the resistance, and in some cases to 5 amperes.

Needless to state, this rule in its many forms, is only an example of such as are made to be violated, as the correct starters which would comply in every respect do not commercially exist. Further, such rules have been made, and copied by various supply authorities without any regard whatever as to what they mean. For example, a 30-H.P. motor on 220 volts, taking 10 amperes on the first step, and 10 amperes per step until the motor started, and 10 amperes increment until full speed was attained, would require the following minimum number of steps in the resistance under varying load conditions—thus, light (say 20 amperes), 12 sections; loaded full current throughout, say 50 sections. Considerations of voltage between the contacts would further slightly increase the number of sections, and it would be interesting to know how many such motors are provided with starters in strict compliance with the regulations. The rules, although badly constructed, simply mean that means must be provided in motor starters, such that the current is raised gradually to the amount necessary to run the motor continuously, and the excess or acceleration current in starting shall not exceed the running current by more than a certain amount.

Liquid Resistances.—There is no doubt that liquid resistances offer the best solution of all difficulties, and when carefully designed afford the most perfect means of control, particularly with reversing motors. Most liquid resistances, however, have at least one of two defects, *i.e.* (1) the current cannot be sufficiently reduced, when the dipping plate is just entering the liquid; and (2) the resistance cannot be sufficiently reduced with the plate all in before short-circuiting the starter, and the consequent rush of current seriously damages the switch parts and abnormally stresses the motor. A good method of overcoming both defects consists in enamelling the pot halfway down on the inside, and arranging the dipping plate to pass between two other plates cast into the pot. The enamel compels the current to pass through a greater length of solution at starting, and gives a much better control.

Suggested Rule for Starters.—As has already been pointed out, considerable divergence exists in the specifications of supply companies as to what is required in a starter, and the following suggested rule may prove a base for a more uniform statement, thus:—"Current on first step not to exceed 10 amperes, or half full load current, whichever is least, but for motors taking more than 50 amperes, 20 per cent. of full load current. The momentary increase of current in cutting out any section of resistance not to exceed 10 amperes, or 25 per cent. full load current, whichever is least, but for motors taking more than 50 amperes, increment may be 20 per cent. of full load current."

In the interests of the purchaser, the following addition may be inserted: "The E.M.F. across any section of the resistance shall be limited to an amount which shall not cause injurious sparking or rapid deterioration of the contacts."

REVIEWS.

Steam Boiler Economy. By Wm. Kent. New York: John Wiley & Sons; London: Chapman & Hall, Limited. 1901.

This book is the work of an engineer who is a recognised authority on the subject of steam boilers in America.

It is, of course, written partially from the American standpoint, and Chapter IV. deals purely with the coalfields of the United States; but generally, it is very applicable to our own practice, for, after all, anthracite and bituminous fuels are much the same wherever found, and all coals lie somewhere between two extremes.

The first chapter is one of principles and definitions, and is generally good. The author falls foul of the late C. Wye Williams for a statement made by him some 60 years ago, to the effect that "When smoke is *once produced in a furnace or flue*, it is as impossible to burn it as it would be to convert the smoke of a candle to the purpose of heat or light." The italics are ours. Mr. Kent says that a smoking candle can be made to give off its smoke into the central draught tube of a lamp, and it will be completely burned, and he says Williams's statement is erroneous. We must entirely disagree. Williams only drew a comparison, and all that Mr. Kent can show in opposition is that of a furnace he tested on similar lines to the candle; it can also be made smokeless, of which we have no doubt, but we believe Williams referred merely to furnaces and candles as they existed. As he wrote of water-cooled flues, was he not right? The author practically says the same thing in a different way. The central draught lamp to burn the candle smoke is simply a means of adding temperature. Otherwise there is no cause for unfavourable criticism of this chapter.

Chapter II. is claimed to treat combustion and temperature more fully than has hitherto been attempted. The treatment is distinctly good, and we think the author wise in calculating the full value of hydrogen in the furnace and subtracting the waste gas values to find the net result. This avoids confusion. Chapter III. calls for little remark, save that the general remarks on coal are correct. In Chapter V. the heating capacity of coals is discussed, and doubt is thrown on Scheurer-Kestner's determination, because Mahler's tests with the Berthelot calorimeter seem more probably true. Mahler's table is reproduced, and Dulong's formula is accepted as a close approximation to actual results. Fuels other than coals occupy the next short chapter. Peat, wood, sawdust, tan bark, straw, and other articles are briefly discussed. In Chapter VII. furnaces are discussed, with methods of firing different fuels. The difficulty of burning bituminous fuel under water-tube boilers is correctly defined. It is curious how persistent water-tube boiler-makers are in trying to perform the impossible feat of burning hydrocarbon gases in a tubular surface condenser, for the attempt is very similar to attempting to run a steam engine with an ice jacket. The ordinary method of soft coal burning is described as the worst, and the opinion is properly supported. The author's requirements for avoiding smoke are:—(1) To distil the gases off slowly; (2) bring them into contact with very hot air; (3) burn them in a brick chamber; (4) keep the burning gases away from cool surfaces, as shell or tubes of a boiler, which means—provide ample space in which to allow the gases to burn.

Perhaps it is owing to the considerable use of water-tube grates for anthracite coal that the down-draught water-tube grate has made such progress in America, for undoubtedly it has been much used. Thus the Hawley furnace is of this type, and embodies two grates, the upper one to carry the main body of fuel, and one below it on which the half-burned cinders may burn as they drop through the upper grate. The products of the upper fire pass through the fire. The space between the two grates forms part of the combustion chamber. Another furnace much used in America is the old Tenbrink grate. This is a grate with a steeply sloped surface in steps, with air admission through the risers. It is only applicable to under-fired boilers, and may be made with rocking bars. Mechanical stokers, as here described, may be passed over. They are practically all English designs, the furnace of E. B. Coxe being the old Juckes furnace once so common in Yorkshire when the boiler insurance companies had not yet secured the abandonment of under-firing of shell boilers. All the chain grate stokers illustrated are practically copies of the old Juckes grate.

The Murphy furnace may be novel, but the under-feed devices seem old friends. Wegener's dust system is illustrated, but not specially recommended. Its weak points are not hit upon by the author.

Boilers are then dealt with in respect of heating surface and rates of combustion. Opinions will differ as to whether the means of calculating efficiency are suited to practice wherein so many uncontrollable variables appear, but figures and results are given that will be useful.

In Chapter X. we find types of boilers illustrated, and we note that the author throws doubt on that useful type of American boiler, the under-fired return-tube boiler, so many of which explode annually.

If allowed pressures still remain what they were a few years ago, we need feel no surprise at this, for pressures in the United States were as high for single riveting as were usual for double riveting in this country, while on the

Mississippi River about 25 per cent. additional above that was allowed for some inscrutable reason. Small wonder then that so many boilers went aloft. Many water-tube designs are illustrated, including the ridiculous design of the Belleville.

The chapter on boiler power is good, so is that on the points of a good boiler, in which is discussed the fact that land boilers are of such various types and not standardised in the way the locomotive boiler has become. It would be difficult, we fancy, to build a good locomotive with other than a close copy of the usual boiler. In land practice the form of a boiler is not in any way controlled by the engine.

Boiler setting is well discussed, errors in firing are pointed out, and the relation of draught, fire thickness and size of coal particles. We are told that the hottest fire is that to be obtained when gas analysis shows about 4 to 8 per cent. of free oxygen. Water, corrosion, treatment are all noted briefly. The chapter on evaporation tests is chiefly a reprint of the code drawn up by the committee of the American Society of Mechanical Engineers. A chapter is added on the results of boiler testing that will be a guide for practice, and a couple of final chapters of tables and miscellany close a very thorough and excellent book.

Production et Distribution de L'Energie pour la Traction Electrique. By Henry Martin. Paris: Ch. Béranger. 1902.

The author claims in this book to have considered rather the means of producing and distributing energy for electric traction than the question of using such current. He considers that previous authors have neglected the first part of the subject, and it is his aim to fill the want. He commences by dealing with tractive effort, and we note that he gives this as 0·010 of the weight of the vehicle for good tramway rails, and 0·020 for dirty rails, while for good railways it is 0·005.

He examines into the question of trailers, and then into the question of power to be furnished. This seems to us almost unnecessary as regards the station power, but important as regards the motors of the car itself. Experience teaches us that a car of 7 or 8 tons will usually require 1 unit per car-mile, and this is as close a basis on which to figure station output as any calculation or statistics as to cars. It is also useful to know the maximum power called for by a single car, because at the end of a line where for perhaps half a mile or more one may elect to rely on trolley wire alone, we must know when the last feeder must come in and how big to make the last bit of trolley wire. It will, of course, usually pay to use a bigger trolley wire in order to save cable and pipes and excavation.

The author gives M. Paul Dupuy's method of finding power, and illustrates it for a load of one ton, which he finds to require 11·08 H.P., or 122 H.P. for a vehicle of 11 tons. He allows 50 per cent. for line loss, and provides 244 H.P. at the station. The matter is not very clear, this power being given for one car, whereas it seems probable that it is meant to apply to the whole 12 cars, for which it should be ample. We think a line efficiency of only 50 per cent. too small to allow. We think his installed horse-power is, however, about right. Our own figures would allot a mean power of about 125 H.P. at the station, with a maximum of about 290 due to load variation. M. Dupuy's method gives 244 H.P. installed, and this with an overload of 25 per cent. would give about 305 H.P. available from the 244 H.P. installed. The sequel also shows that the whole 12 cars must be meant.

He adds a table of horse-powers per car for systems of one to 30 cars, the figures for which appear remarkably in accordance with facts. A diagram is added for the graphic determination of powers.

He next deals with the choice of the number of station units required for different magnitudes of station, and gives several tables of the equipment of existing stations, and draws attention to the effect of accumulators, naming Remscheid as a place where three units or sets were run prior to accumulators, and the work was done by two sets after the battery was installed. He rightly points out the need for batteries in gas-driven stations.

The chapter on boilers is very general, but contains a few plans for station general dispositions, and treats of water purification very briefly. The plans and elevations are largely from American sources, the Hunt coal conveyer being illustrated in some detail. Chimneys and artificial draught are very briefly treated, and so is the question of the deterioration of boilers. Engines are more fully described with some detail of illustration and a few other more pictorial plates. High speed, of course, brings a few English engines to the front—the Willans and the Parsons turbine.

Condensation and water cooling is very briefly treated, and the steam-power portion of the book gives us the impression that the author has sound but not expert knowledge of this branch of the subject. He is very much more full in Chapter V., which deals with gas-driven stations, that is, in proportion to the general knowledge of gas stations, and he goes into some detail also on water turbines, which receive some well-executed illustrations. When he comes to electrical work we seem to see he has reached work that interests him more fully than power generation, but even here there is not what we should like to see in the way of full detailed particulars of the length and section of windings and full technical descriptions of railway generators. Possibly, as with the steam engine of a hundred years ago or even less, makers of electrical machinery follow the system of keeping things dark.

This section of the book closes with a chapter on costs. But three-fourths of the book is yet to come. The second part takes up distribution, giving a diagrammatic method of finding feeder points. The fall of potential is allowed, as here, to be only 10 per cent. Nearly 200 pages are given to feeders and overhead work and details, which are very copiously illustrated with views of every detail and some views of English construction, also some wooden pole work and construction tools. Trolleys and bases and bows come in for full description, and evidently the author is most interested in this part of his task.

Other systems than the overhead are also allotted much space, third rails, conduits of several types and surface contacts.

The Diatto and the Dolter systems are both given space, with many others, and they are all pretty fully illustrated and impartially described in a non-controversial manner. Bonding, bonds, rail return and electrolysis all come in for review with copious illustrations of solid and plastic bonds, electric welding and Falk welding, with details of cost.

A final section deals with French rules and regulations.

The methods of keeping down rail resistance are illustrated by numerous examples.

In France the law does not permit a rail drop of more than 1 volt per kilometre, and the total loss of tension must not exceed 5 volts. This is more stringent than our Board of Trade rules. An iron bridge in France must be so connected that its two ends shall not differ by more than 0·25 volt.

It appears there are in France, or in French control, at least three tramway stations driven by gas engines, viz., at Orleans, Poictiers, and Tunis. They are provided with Dowson or Pierson gas plants, and use engines of Crossley type. The objections to gas, in the eyes of the author, appear to consist in the limited range of fuel that can be used. English anthracite, he says, is the best, but such fuels are costly when compared with, perhaps, local fuels. It would appear that bituminous producers are not well known to the author.

In Germany there are gas-driven tramway power stations, at Cassel and at Clausthal, and in Switzerland at Lausanne and Zurich.

While we think that the author has attempted too much for a single volume, and must award the most praise to the distribution portion of this work, we must say he has collated an enormous mass of detailed information, and selected it well. Engineers who are familiar with metrical units, will do well to possess themselves of the book, for even where it may appear too brief, it is suggestive.

An interesting section is that on accumulators, especially the part describing the Pirani system, as installed at Fontainebleau. The accumulator is placed across the bus bars in series, with a booster with a double winding. One wind-

ing opposes the other. The one winding is connected between the booster and the accumulator, and through a resistance to the negative. It therefore derives its current from the battery. The other is placed on the positive, and takes the full line current. Where the line calls for much current, the latter winding prevails, and the booster helps the battery to discharge. When the demand for current is small, the other winding prevails, and the booster helps to charge the battery. The resistance enables the critical point of neutrality to be fixed to suit conditions. The author quite appreciates the special use of a battery in a power station and the economy to be had from using them. In large stations many engineers fear their expense. In a small station a battery will enable engine power to be reduced by two-thirds, or even three-fourths, but while it will do this, it must be remembered that the battery must be large enough to deal with the eliminated large fraction of power. In a large station, on the other hand, though the battery may only save one-half or one-fourth of the engine power, it may bear smaller ratio to the engine power.

Thus, in two stations with an output of 100 and 800 amperes respectively, the batteries to be installed would require to deal with about 80 amperes in the small station and 450 amperes in the large station. The capital cost per car run would be only as 80 to 55. The battery gives a less ratio of economy, and involves a less ratio of outlay to give that economy. It might be added that batteries with a heavy discharge rate for short periods might always be employed to cut off the peaks of a load curve without being called on to reduce the load curve to an even line. Indeed, so long as the battery is properly regulated to its capacity, it will serve to reduce the range of the engine duty, and should pay for itself.

We can cordially recommend this book, though, for engineers, some knowledge of the metrical system will help them to easier perusal of it.

The Cyanide Process of Gold. Extraction. By James Park. London: Charles Griffin & Co., Limited, 1901. Price 7s. 6d.

This is the second edition published in England, though three have been previously published in New Zealand. The first was reviewed in our issue of July 20th, 1900.

The two chapters originally devoted to leaching and washing are now wholly revised and condensed into one, and the appendix on "Cyaniding in New Zealand" is now introduced into a valuable chapter dealing with the "Application of the Process" in all the more important countries.

The author states that the electrical precipitation method of Siemens-Halske has been introduced with marked success at a number of cyanide plants at the Witwatersrand goldfields, and its use is extending.

HIGH-SPEED ENGINE DESIGN.

The high-speed engine seems to have developed almost entirely as a vertical engine; yet the vertical engine has faults from which the horizontal engine is free. Thus in respect of water in the cylinder, the vertical engine is badly arranged for getting rid of it. Suppose that at the top of the piston travel all the water is projected into the steam port; then, at the next steam admission, this water is spread forcibly over the interior areas. At the bottom of the cylinder things are different. The water tends to the lowest point, and is carried away with the exhaust. But at the top side the exhaust is actually closed before the piston has lifted the water so high as the port. This difficulty is got over in engines of the central valve type, for the coning of the piston is towards the centre, and the water begins to escape as soon as the exhaust is opened. In other engines of the single-acting variety, when the piston is coned downwards from the centre there is a ring of small holes near the bottom of the stroke of the piston. These holes are uncovered by the piston, and all water that has got so far down the cylinder is carried out at these holes by the exhaust. The steam that still remains in the cylinder is dealt with by the ordinary valve. The method permits of this being reduced in size, for the first rush of the exhaust goes out at the ring of holes. The method seems to be adopted with single-acting engines only. It is not used, so far as we know, in engines of the double-acting type, because the holes would let out the steam from below the piston. High revolution engines have usually so short a stroke that were the pistons made as deep as the stroke or thereabouts, a single ring of holes round the middle of the cylinder would be uncovered by the piston when this was both at the top and bottom of its stroke. Thus, in an engine with a piston travel of 6 in., the piston would be nearly 6 in. deep and the exhaust from both ends of the cylinder in turn could escape this way, and the top of the cylinder would be kept much drier than is now possible.

In seeking for lightness of parts, many engine makers go to extremes. We cannot think it good practice for the piston depth of a high speed engine to bear so small a ratio, as it frequently does, to the cylinder diameter. When a small ratio is adopted, the length of the central boss is also short, and the piston has a poor and unsteady hold on the rod, especially as there are certain difficulties of design in the way of employing a long taper in this detail. A narrow or shallow piston is more excusable when the piston rod is carried through both ends of the cylinder, but without this precaution there are grave risks of the piston seizing the walls of the cylinder, especially in case of uneven lubrication, for the resistance at one part tends to throw the piston out of truth in such a way that it binds in the cylinder at opposite top and bottom edges. Where a piston is long this cannot happen. A long piston can never set itself, so to speak, cross-cornered in a cylinder. An aggravated instance of this trouble would be furnished in the case of a piston composed simply of a thin flat plate. It would be very difficult to push such a piston through its cylinder without throwing it out of truth, one side leading somewhat. There is little doubt that this is the effect produced upon the shallow pistons one sometimes sees placed in high-speed engines. No doubt the object is chiefly to save height in the design. It is a mistake to carry such economies so far; the economy of material and shop labour is very small indeed, and must be far outweighed by the consequential expenses which arise when the results manifest themselves in engines at work. Moreover, within reason, a deep piston holds lubrication very much better than a short piston. At one time it was the practice in America to make pistons so long that a band at the middle of the cylinder never was uncovered by the piston; probably this was carrying a good thing to excessive lengths. To sum up, a long piston will work with less friction and less waste of steam; it will permit of the top end of the cylinder being drained—an advantage that cannot be attained in any double-acting engine of usual types; no serious extra expense is involved, and the results will be very much better.

WEST HAM CONTRACT CONDITIONS.

We have recently had our attention called to a specification issued by the West Ham Town Council, asking for tenders for a 12 months' supply of house fuse boxes. The estimated number required was about 200, and the value approximately £150.

Prices were asked for 11 sizes, based on orders for one dozen of each size being ordered at one time, so that the probable value of any order, at any rate for one size, would not exceed £20.

And yet we find the following stipulations amongst the general conditions:—

(*a*) Two sureties to be named willing to enter into a bond in the sum of *two hundred pounds* for the due and proper observance by the contractor of all the terms of the contract.

(*b*) These sureties to attend personally at the Town Hall, Stratford, to execute this bond.

(*c*) Contractor to undertake to pay such rate of wages and observe such hours of labour as are accepted as fair by the trade unions and employers in the district.

(*d*) In case of failure by the contractor to deliver goods ordered under this contract within *six weeks* from date of instructions, to pay *one pound per day* for every day late.

(*e*) If any portion of the contract is sublet without the consent in writing of the Council, contractor to forfeit the sum of *fifty pounds*, and if the contractor or his agent give any gratuity to any officer of the Council, the contract may be determined by the

Council without any liability on their part to pay any compensation to the contractor.

(*f*) The Council do not undertake that the quantities ordered may not fall short of the number stated.

Particular attention is called to clause (*e*), which it is stated will be strictly enforced.

We feel sure that our readers will join us in considering these conditions totally out of place in a contract such as this. We cannot imagine any sane business man agreeing to pay *six pounds per week* penalty in case he is *one week* late in delivering one or more fuse boxes worth, on an average, under *one pound* each. Quite apart from its legal aspect, and in our opinion, it is quite unjustifiable from this standpoint, the charge is preposterous. The same may be said of the claims put forth in claims (*a*) (*b*) (*c*). The purchaser, in laying down such conditions, is arrogating to himself a function quite outside his province as a trustee of public money. It is his duty to obtain for his constituents a fair return for money expended. By surrounding even small purchases of this description with clauses of this character, he is compelling a manufacturer to unduly increase his prices in order to protect himself against the additional risks, and the result is that the person to eventually suffer is not the manufacturer, but the purchaser, or in the case in question, the purchaser's constituents—the ratepayers.

It may be said that to raise such a question over a small amount like £150 is unnecessary, but it is the principle we protest against, and the injustice is just as real to the small manufacturer, with his unimportant contract, as to the large contractor with his order for large units of plant.

We are glad to know that many firms refuse to submit to such extravagant claims, and we hope that in time the ratepayer will be educated up to the point, when he will insist that his representatives on public bodies study his real interests in small matters as well as in great ones.

PHYSICAL SOCIETY.

Annual General Meeting held February 14th, 1902.

Mr. T. H. Blakesley, Vice-President, in the Chair.

The officers and Council for the following year were elected as follows:—

President: Prof. S. P. Thompson, D.Sc., F.R.S.

Vice-Presidents: Members who have filled the office of president, and T. H. Blakesley, M.A.; Prof. J. D. Everett, D.C.L., F.R.S.; S. Lupton, M.A.; J. Walker, M.A.

Secretaries: H. M. Elder, M.A.; W. Watson, B.Sc.

Foreign Secretary: R. T. Glazebrook, D.Sc., F.R.S.

Treasurer: Prof. H. L. Callendar, M.A., F.R.S.

Librarian: W. Watson, B.Sc.

Other Members of Council: C. Chree, D.Sc., F.R.S.; W. R. Cooper, M.A.; G. Griffith, M.A.; R. A. Lehfeldt, D.Sc.; A. W. Porter, B.Sc.; W. A. Price, M.A.; W. N. Shaw, M.A., F.R.S.; W. F. Stanley, F.G.S.; J. Swinburne; A. A. Campbell Swinton, M.I.C.E.

Prof. S. Langley and Prof. H. A. Lorentz were elected Honorary Fellows to fill the vacancies caused by the deaths of Prof. Rowland and Dr. Koenig. The President of the German Physical Society was elected an *ex officio* Fellow of the Society.

The Secretary then read the President's address. It commenced by giving some particulars of the life and work of Rowland, Koenig, Langley and Lorentz. On January 11th a telegram was sent in the name of the Society to Prof. Hittorf, congratulating him upon the jubilee of his professoriate. The work of translation, revision and production of an English version of Gilbert's "De Magnete" has been completed, and a copy of the book presented to the Society by the President. The remainder of the address dealt with the refusal of the law of this country to recognise, as valid matter for the granting of letters patent, anything which may have been brought before any of the learned or scientific societies. In the United States a man may appeal to the fact of his having read such a paper in proof of his subsequent claim to receive a valid patent for his invention. The law in this country works very inequitably. As examples, the invention of the microphone by the late Prof. Hughes, the President's invention of the "Astigometer" and the invention of wireless telegraphy by Prof. Lodge were given.

An ordinary meeting of the Society was then held, at which Mr. Littlewood exhibited an Attwood's machine.

The Society then adjourned until February 28th.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1902.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London W.C., and at Liverpool, to whom all inquiries should be addressed.

2,685. "Improvements in apparatus for turning or grinding, in position, the commutators of dynamo-electric machinery." W. Sutton and S. Lord. February 3rd.

2,694. "Improvements in or relating to knobs or buttons for electric switches." F. G. Butcher. February 3rd.

2,700. "Telephone exchange circuit." G. Lambert. February 3rd.

2,701. "Improvements in telephone line jacks." G. Lambert. February 3rd.

2,732. "Improvements in coin-freed electricity meters in part applicable to other purposes." G. Hookham. February 3rd.

2,736. "Improved magneto-electric ignition apparatus for gas engines." G. Honold. February 3rd. (Complete.)

2,763. "Adjusting appliance for electric tramcar trolleys." E. H. Lawson. February 4th.

2,774. "Improvements in electrical switches." R. F. Hall. February 4th. (Complete.)

2,816. "Battery." C. A. Allison. (W. C. Banks, United States.) February 4th. (Complete.)

2,820. "Improvements in voltmeters." P. Garoti and R. Pompili. February 4th. (Complete.)

2,825. "Improvements in time electric switches." H. F. Goguel. February 4th. (Complete.)

2,828. "Improvements in rail bonds or connecting strips for electric railways." M. F. Whiton. February 4th.

2,840. "Improvements in street lamps or lanterns for incandescent electric light." E. Stanley and The British Prism Globe Electrical Company. February 4th.

2,847. "Improvements in or relating to electric cables." S. Bibby. February 4th.

2,950. "Improvements in and relating to electric distribution systems." C. G. Watson. February 5th.

2,959. "Improvements relating to telephone systems." A. K. Andriano. February 5th. (Complete.)

2,984. "Improvements in apparatus for use in starting and controlling electric motors." A. H. Adams and J. T. Mould. February 5th.

2,990. "Improvements connected with incandescent electric lamps." J. Swinburne and M. Solomon. February 6th.

3,024. "Improvements relating to electric traction by the surface contact system." B. Cruvellier. February 6th. (Complete.)

3,059. "Improvements in and connected with current collectors for electric vehicles." L. Lavagne and L. Bertrand. February 6th.

3,061. "Improved automatic shunt coil core for arc lamps." A. E. Carter. February 5th.

3,063. "A double acting arc lamp brake for the perfect feeding of the carbons at a uniform rate." F. Carter. February 6th.

3,116. "Improvements in safety fuses for electric circuits." A. D. Smith. February 7th.

3,134. "Improvements in or relating to trolley heads used in connection with overhead wires for electric traction." J. Greenwood and J. Hartley. February 7th.

3,141. "Apparatus for repeating semaphore signals by electric bell in cab of engine, during foggy weather or falling snow." E. Twaits. February 7th.

3,142. "Improvements in or relating to safety devices for electric overhead conductors." A. J. Boult. (L. Negro, Italy.) February 7th.

3,153. "An electro-magnetically operated switch for opening and closing an electrical circuit." C. E. G. Gilbert. February 7th.

3,157. "Improvements in arc lamps." H. T. Harrison and The Improved Electric Glow Lamp Co., Ltd. February 7th.

3,163. "Improvements relating to the secondary circuits of alternating currents." R. Grisson. February 7th.

3,165. "Improvements in and relating to multi-polar electrical machines. D. Bergman. February 7th. (Complete.)

3,176. "Improvements relating to telephony." T. J. Rorke and E. Rorke February 7th.

3,224. "Improvements in switch systems for telephone circuits." L. Cere Botani and M. Baumer. February 8th. (Complete.)

3,248. "Improvements in electric signal register and telephone systems.' P. Jensen. (The Yurgae Signalphone Manufacturing Company, United States. February 8th. (Complete.)

3,272. "An improved method of making carbons for arc lamps and the like." W. P. Thompson. (C. Conradty, Germany.) February 8th.

3,273. "Improvements in processes for making carbons for arc lamps and the like." W. P. Thompson. (C. Conradty, Germany.) February 8th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d (in stamps).

1900.

9,768. "Improvements in the manufacture of electric railway, rail bonds, and other electric couplings or terminals." T. J. McTighe. Dated May 28th, 1900. Rail bonds for electric railways, dynamo terminals, clamps for attaching conductors to "bus bars" and the like are made of cast or drop forged copper, with a socket for the reception of the ends of the flexible cables on to which they are swaged cold and under great pressure, so as to cold-weld them, by dies. 6 claims.

9,781. "Improvements relating to primary batteries." E. P. L. Mors. Dated May 28th, 1900. Relates to zinc-carbon batteries, and consists in making the carbon in the form of a tube provided with orifices. The zinc may be suspended in the tube, and the cell may be provided with a cover. 1 claim.

9,836. "Improvements in and connected with the conduits of electric railways,' J. B. Larkin. Dated May 29th, 1900. Relates to electric railways and tramways on a conduit system with slot-closing arrangements. Conduits; collectors: The conduit is constructed of two L-sections bolted to the sleepers and held apart by distance-pieces with dovetail end connections. These pieces are perforated to carry feeders, and they also carry the conductor supports, while their tops act as bearings for the two lines of slot-closing plates. The plates are grooved to embrace the top flanges of the conduit, and are closed by springs. Hinges connect them at their ends, and they are opened by a plough, which is pivoted under the vehicle. The collector can be lifted out of the conduit by a cord running to the driver's platform, and a button on this cord engages and lifts the plough. 55 claims.

9,873. "Improvements in electric motors, batteries, and connections thereof for propelling automobiles and like vehicles." J. Hewitt, C. A. Lindstrom and T. Hewitt. Dated May 29th, 1900. Relates to electric motors, batteries, and connections thereof for propelling automobiles and like vehicles. Two independent motors are employed for propelling one axle, or the opposite wheels on one axle. They are supplied with current at a low voltage from a secondary battery, the fields of the two motors being permanently connected together in parallel and their armatures in series. 4 claims.

9,879. "Improvements in or relating to electric incandescence lamps." R. Krayn. Dated May 29th, 1900. Relates to a lamp having a filament requiring preliminary electric heating to render it conductive, and having in its base an automatic interrupter to open the circuit of the heater when the filament has become conductive, used with one or more ordinary incandescent lamps. These are connected in parallel with the heater and give light immediately and so long as current is supplied to it. The auxiliary lamps may be either combined with or separate from the principal lamp. 1 claim.